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Telephony and Telegraphy.

THE HOME TELEPHONE COMPANY'S SYSTEM, MOBILE, ALA.

A LARGE number of independent telephone companies throughout the country have been organized from time to time, and among them are to be found various kinds of equipments, some of which differ considerably from the familiar instruments of the Bell company. The Home Telephone Company, of Mobile, Ala., is one of the independent companies whose equipment is radically different from those generally seen. This system is the invention of Mr. Paul Minnis, the manager of the company, and as the instruments and appliances are extremely novel, we have described them in considerable detail.

Paul Minnis.

LINE AND STATION CONNECTIONS.

The general features of the system are clearly shown in Fig. 1, which represents a central station and two line stations, S and S′. The latter are in connection with the switchboard and with the main battery at the central station by means of one independent service wire, L, L′, to each line station, and by a common return wire, R, thus providing a complete metallic circuit, which is primary, being without induction coils. A single main battery, B, is connected in series with the line station and the central station which charges the line with a direct primary current. There is also a series of small batteries, T-B, one of which is directly connected with each pair of flexible cords at the central station, the indulations set up by the vocal vibrations being thrown upon the wires through the latter. A small incandescent lamp, D, is connected in multiple arc to the main battery, the lamp circuit being closed by devices operated by the current from small batteries, one of which is connected through one of the flexible cords with a circuit which is closed and opened at the line station. This closure is effected by the subscriber in using his telephone and the opening is automatic, whereby the signal, which is the equivalent of the "ring-off" now in use, is given to the central station the instant that conversation is at an end without requiring an action by the user of the telephone depending on his volition.

The series of small batteries is equal in number to the flexible cords in the central station, each cord being connected to one of the batteries by dividing it and connecting the severed ends directly to the opposite poles. These "talking batteries" are thus upon a normally open circuit, except at such times as the different service wires are brought into use. In this manner the common return wire is charged with as many separate direct primary currents as there are complete lines of communication in use, without the intervention of induction coils. There is thus obtained a common charge in the return wire having an amperage proportioned to the number of service wires in use at any given moment, the charge in the common return wire varying as the number of service wires in use increases or diminishes, the final object being to mass or combine the individual currents from the separate talking batteries in one common fund of electromotive force at a point where it can be equally drawn upon for the wants of each of the service wires in use without regard to whether the current used in any particular line station comes from the particular battery connected to the cord by which station is brought into communication with another station, or drawn from some other one of the series of talking batteries; or, in other words, from the aggregate or common charge of electromotive force present in the common return wire, a single main battery is provided to operate the annunciators and to light the lamps which denote to the operators at the central station that the service wires are in use.

THE CALLING APPARATUS.

The neglect of subscribers to "ring off" at the end of a conversation is perhaps as fruitful a source of annoyance and delay as any occurring in telephone service. In the new Mobile exchange the trouble has been entirely eliminated by an automatic ring-off system, which will be readily understood from the following: The arrangement is such that it leaves no act to be performed by the person using the telephone, except to release the handle of the instrument, by which the central station is at once notified that the line is no longer in use between the stations. The system of circuits is very clearly shown in Fig. 1. The call box shown in Figs. 2 and 3 consists of a casing provided with a hinged cover, which carries the bell-signaling mechanism. Arranged centrally within the casing, is a spindle, O, Fig. 3, to which is secured a stud that has a bearing in the lower end of a pedestal, rigidly secured to the cover and carrying the gong of the bell-signaling mechanism. Loosely arranged on the spindle, so as to rotate thereon, is a sleeve, c, and a reel is rigidly attached to this sleeve so as to rotate with it.

A coiled spring is disposed in a recess in the bottom of the

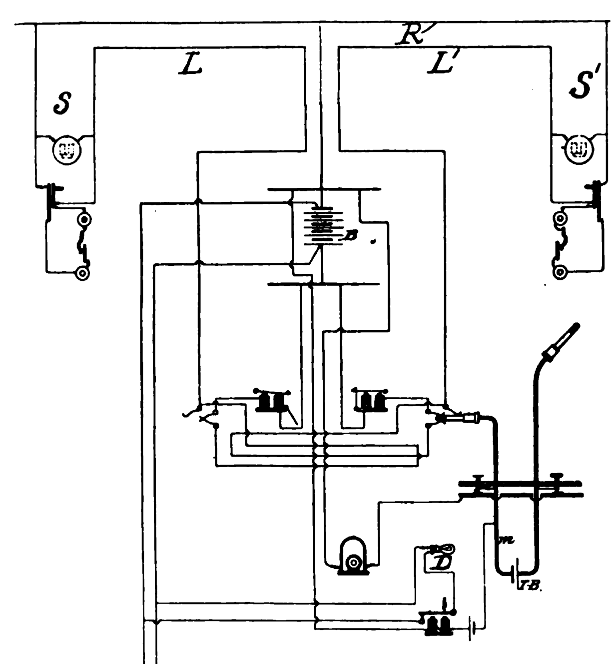


FIG. 1.—DIAGRAM SHOWING CONNECTIONS BETWEEN SUBSCRIBER AND EXCHANGE.

casing, one end of which is secured to the wall of the recess and the other end to the sleeve. On the opposite ends of the reel are discs, to one of which is secured a ratchet wheel, W, the teeth of which engage a bell crank shaped pawl, P, which is pivoted at one end to a bracket attached to the rim of the casing and at its other end is provided with a hook, H, upon which are

hung the receiver and transmitter. The coiled spring is interposed between the pawl and the rim of the casing and operates to normally hold the pawl in engagement with the teeth of the ratchet wheel.

The two conductors, A, lead from the receiver and transmitter through an aperture in the casing and are wound about the reel, the terminals being respectively soldered to the upper

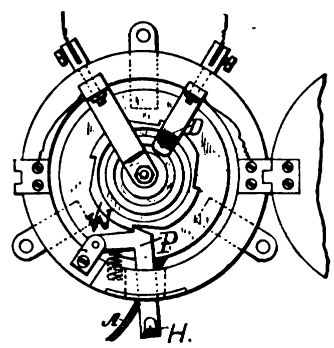


FIG. 2.—SUBSCRIBER'S CALL BOX.—PLAN.

flanged end of the sleeve and to an annulus attached to the disc. Resting upon the flanged end of the sleeve is one end of a spring contact, D, the other end of which is secured to a binding post that passes through the casing and is secured in place by a nut tapped over the inner threaded end of the binding post. The nut also serves to attach the spring contact to the binding post. A spring makes contact with the annulus and is connected with the other line wire.

The coils of the bell magnets are electrically connected to the

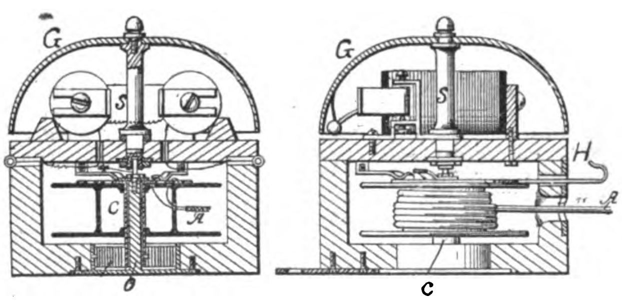


FIG. 3.—SUBSCRIBER'S CALL BOX.—SECTION.

hinges by wires and the gong is provided upon its inner edge with two shoulders arranged in proximity to each other, between which the bell hammer vibrates.

Let it be assumed that the device is supported in position with the lid or cover closed and all the parts in their normal position. To call up the subscriber, an alternating current of short duration is sent over the line wires from the central office by a magneto-generator in the ordinary manner and the circuit is closed through the contact wires and hinges through the bell magnets, and thence over the return wire to the central office.

Upon the subscriber removing the combined receiver and

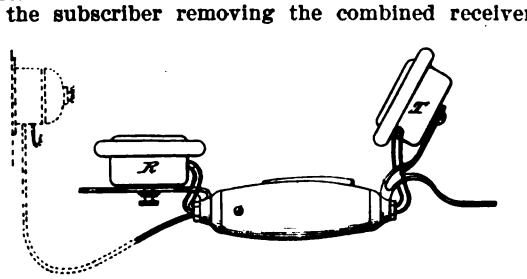


FIG. 4.—THE RECEIVER-TRANSMITTER.

transmitter from the hook, H, Fig. 2, the small coil spring forces the pawl into engagement with the teeth of the ratchet wheel; but the teeth are so arranged that the wires, A, may be unwound from the reel against the tension of the main spring to permit the receiver and transmitter being adjusted to the ears and lips. The pawl, however, prevents the reel from being rotated by its spring in the opposite direction to wind up the conductors.

Conversation may now be carried on between the two communicating parties, upon the conclusion of which the subscriber replaces the receiver and transmitter on the hook, and the pawl is thus retracted from its engagement with the ratchet wheel, upon which the main spring will rotate the reel and wind up the conductors. By this means the conductors are retracted within the casing at all times when the telephone is not in use, where they are out of the way and removed from all danger of accidental and forcible disturbance by which the telephone and its connections would be rendered liable to derangement.

COMBINED RECEIVER AND TRANSMITTER.

Fig. 4 shows the arrangement of the receiver and transmitter, which are mounted on a single handle in such manner that when the receiver is applied to either ear the transmitter will

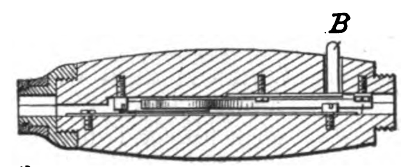


FIG. 4A.—SECTION OF HANDLE.

be in a proper position for conversation. The size and weight of the parts are small and their arrangement is such that they are easily manipulated and the convenience and ease of the user greatly promoted, as the telephone may be used while sitting or standing, or even by persons compelled to recline. Instead of employing a gravity switch use is made of a "palm-switch," A, shown in section in Fig. 5, which is closed by the mere grasp of the hand in holding the receiver to the ear. When the receiver is released this switch opens automatically, thus cutting the transmitter and receiver out of circuit with the line. There is also provided a second switch, B, Fig. 4A, which is normally open, in the handle of the telephone, whereby the subscriber may, by closing the switch, complete a call circuit through an instrument at the central station, thus avoiding the necessity of placing a magneto call generator at each line station. This second switch is closed by pressing a finger upon a push key, B, which projects through the handle, the arrangement being such, however, that the functions of this switch can, if necessary, be performed by the "palm-switch" already referred to.

In this system the whole apparatus at the line station is reduced to the call box and the telephone, shown in Figs. 2 and 4. This is not only a material reduction in the technique of the system, but it reduces the expense of installation, as well as the current expenses, there being no occasion for repairs, except, perhaps, upon rare occasions. There are no local batteries to be drained by careless persons who leave the receiver swinging by its cord and fail to "ring off," and the use of a gravity switch, which makes it necessary to hang the instrument up after use in order to cut the telephone out and switch the bell coils into circuit with the line, is avoided. Moreover, besides the evident ease and convenience to the user, who can assume any position within the range allowed by the length of the flexible

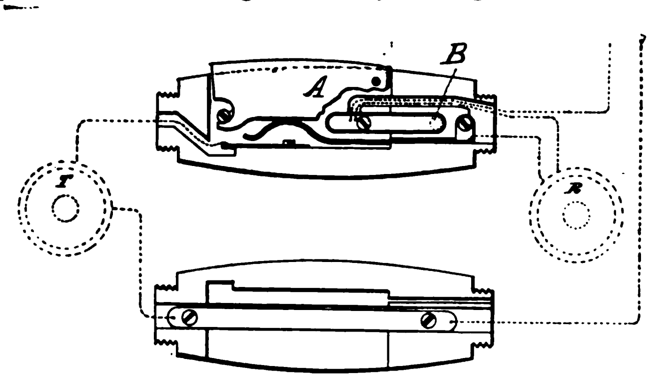


FIG. 5.—HANDLE OF RECEIVER-TRANSMITTER.

cord, there is no necessity for employing skilled labor in equipping a line station.

THE SWITCHBOARD CONNECTIONS.

The wire connections of the switchboard are shown in diagram in Fig. 6. Each line station, S, S′, is connected by a service wire, L L′, to the central station switchboard as shown, and connection is also made to a single return wire, R′, of such

diameter as to equalize the aggregate resistance of the service wires. This return wire forms part of the path traversed by the currents from all the service wires, and it is not connected to earth at any point.

The return wire is connected by a tap wire to one pole of a

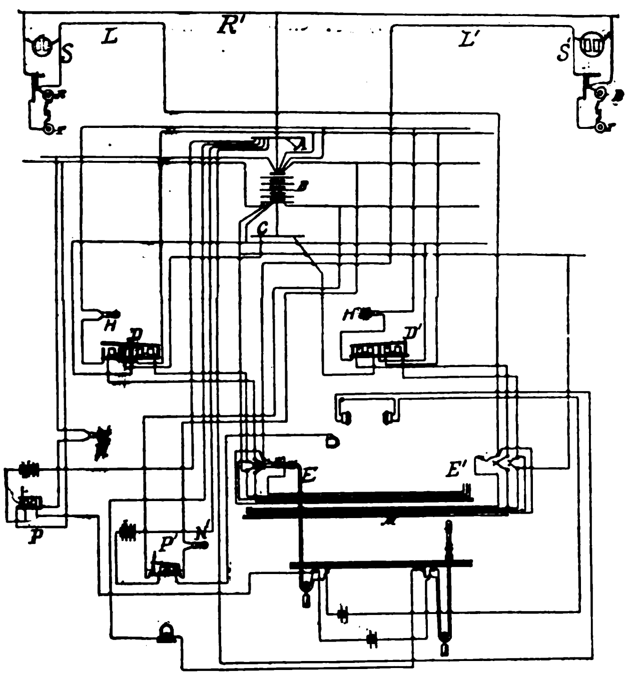


FIG. 6.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

single main battery, B. This tap wire also connects electrically with a spread terminal, A, which lies between the return wire and the main battery. The other pole of the battery, B, is connected to a second spread terminal, C. From this latter a wire is carried to the first terminal of the helices of a pair of electromagnets, D D', and from the second terminal a wire is led to one of the line jacks of the switchboard at the central station, E E', which has two closed spring contacts, and to the former of which the wire is connected.

From the other spring contact a wire goes to the multiples,

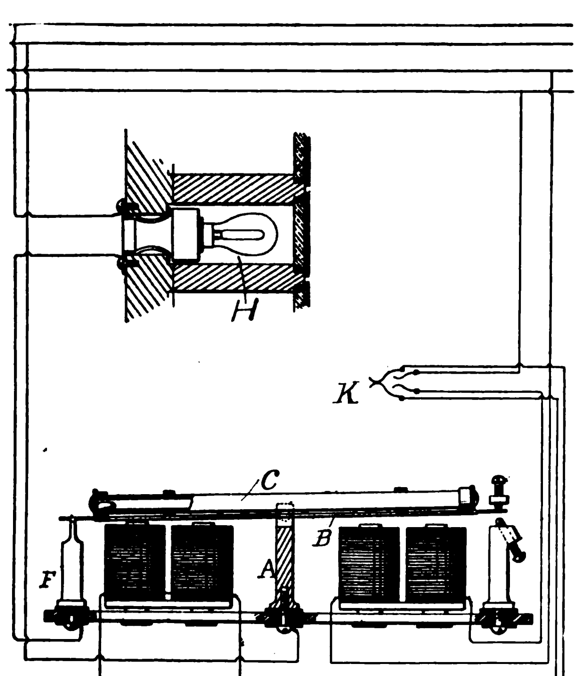


FIG. 7.—THE ANNUNCIATOR MAGNET AND LAMP.

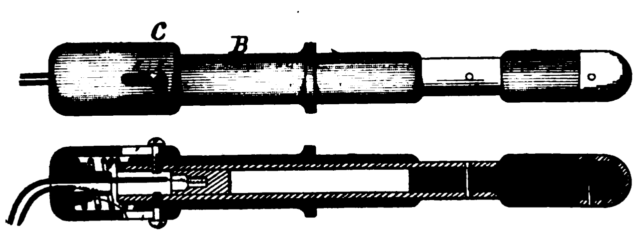
M, of the switchboard, and from these a wire is carried to a single spring contact which is in the same line jack with the closed contacts. From the single contact the service wire is led to the line station, where it forms a loop having two branches, between which the bell coils are placed in bridging connection. Beyond these coils the transmitter, T, and receiver, R, are connected in series, and from these parts of the telephone one branch of the loop is led to the return wire.

The circuit, which includes the service wire, single contact wire, multiples, M, closed contacts, and electromagnets, spread terminal, battery B, tap wire and common return wire, is normally complete at every point except at the line station, where the switch is placed in the handle supporting the receiver and transmitter, as described above. This switch is normally open, and by closing it the person using the telephone is able to send a current from the battery, B, over the circuit last described. The action of this current is as follows:

THE ANNUNCIATOR LAMP AND MAGNET.

The electromagnets, Fig. 7, are arranged at the central station in convenient proximity to the switchboard and the lamps, H, are in full sight of the operators. There are a pair of these magnets for each line station, the circuit in each being similar to that already described. By reference to it, it will be seen that the pair of electromagnets are mounted upon a base from which they are insulated. Rising from this base is a post of conducting material, A, on which is accurately balanced an armature, B. Upon this armature is mounted a small glass tube, C, which is also in equilibrium, so far as regards an equal apportionment of its weight upon both sides of the fulcrum on which the armature is balanced.

Within the tube, which is closed at both ends, is placed a globule of mercury, which is free to run from end to end of the tube when the latter is inclined even slightly. Mercury is the only substance suitable for this purpose, as it will move on a very slight inclination and with great swiftness, so that an instantaneous tip of the armature will be sufficient to enable the mercury to travel past the center and depress the end toward which it moves. The armature forms part of the derived circuit, the extremity which is adjacent to the magnets being prolonged to form a contact which rests upon the end of a second post. The wires go, as already stated, to the terminals of



FIGS. 8 AND 9.—THE SWITCH PLUG.

the magnets. From the fulcrum post a wire is led to a feeder and from the contact post, F, a wire is led to one terminal of a small incandescent lamp, H. From the second terminal of the lamp a wire goes to a second feeder.

These feeders are connected, respectively, to the opposite poles of the main battery, B, and are open, except through the multiple arc connections to the lamp. Each of these lamps is inclosed in a small housing, having a transparent wall, on which is displayed the number denoting the line station. Thus by merely closing the switch at the line station the lamp circuit is established and maintained after tne switch is released by the armature, overbalanced on one side by the mercury globule.

The end of the armature opposite that forming the contact has a prolongation which lies between two stops, both of which are adjustable in a post upon the base. This post is insulated and forms no part of any electrical circuit. Beneath the adjacent end of the armature is a pair of electromagnets, insulated on the base. The first terminal of the magnets is connected by a wire to a tap wire, which is led to one pole of the main battery, B. From the other pole of this battery the circuit of the magnets is by way of a wire to spring contact, K, one of a pair arranged in the same line jack with the contacts. The second contact of the pair is arranged over the first contact, but not in touch with it. From this second spring contact a wire goes to the second terminal of the magnets.

When the operator at the central station answers a call and inserts the plug on one end of the flexible cord in the line jack, the conducting cap upon the end of the plug engages the two contacts and closes the circuit, which includes the helices of the electromagnets. This attracts the corresponding end of the armature, drawing it down and causing the mercury globule to run to that end of the glass tube, C, thus maintaining the armature in the position it is caused to assume by the attraction of the magnets. The rise of the terminal contact breaks the circuit of the lamp and extinguishes it, its ignition being the call signal by which the central station was notified

that the line station desired to communicate with another station.

BUSY TEST.

It is well known that in most telephone exchanges the switchboard is divided into sections, each containing as many separate connections as can be served by a single attendant, and containing, moreover, multiples or duplicates of all the remaining connections. One purpose of these duplicate connections in each of the divisions of the switchboard is to enable any one of the operators to connect a line station served by that operator with any one of the line stations served by an operator having charge of another division, and to be able, more-

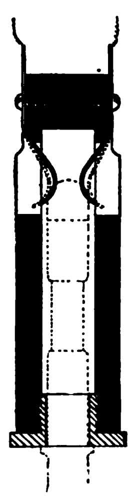


FIG. 10.—ARRANGEMENT OF LINE JACKS.

over, to ascertain easily and instantaneously whether the line station with which communication is desired is already using the service wire which connects that station to the switchboard. It is one of the special purposes of this system to provide means for accomplishing this with absolute certainty with the minimum expenditure of time, care and manual action on the part of the operators at the switchboard, and without the necessity of addressing a question to either line station and awaiting a reply. The means provided for this purpose are as follows: At the central station, in convenient proximity to the switchboard, so that the attendants can readily see the same without changing their position, are arranged a series of small lamps, N N', Fig. 6, each identified with one of the panels of the switchboard. Each lamp has its own independent circuit, which is closed and opened in the following manner. One lamp terminal is connected to a post which forms a support for the armature of a pair of electromagnets, P P', which are arranged, when energized, to attract the armature which is normally raised by a spring.

When attracted, the prolonged end of the armature is brought into contact with a post, and from this post a wire is led to a feeder. This feeder goes to one pole of the main battery, B, and the other pole of the battery is connected to a second feeder. From the latter a wire is led to the second terminal of the lamp.

The circuit, by means of which the magnets are energized, is as follows: From one terminal of the magnets a wire goes directly to one pole of a battery. From the other pole a wire goes to the spread terminal, from which point the circuit is by the tap wire, return wire, to the line station. Here, if the line is closed, the current passes through the telephone and over the service wire to the single contact in the line jack. Thence, a plug being inserted in the jack, the path of the current is through contact piece, bushing, face plate, conducting strip of the jack, and thence on by wire to the corresponding multiples and to their respective face plate through their respective contact strips. The circuit is completed by a wire from the second terminal of the electromagnets to a test thimble. This thimble is worn by the operator upon one finger. It is made of insulating material and has a metal tip to which the wire is attached. The pressure of this metal tip against the face plate of any line or multiple jack that is in use closes the test circuit, energizes the electromagnet, attracting the armature and drawing it into contact with the post, thus closing the circuit of the lamp by the lighting of which the operator is notified that the service wire thus tested is in use. Should the line be idle, the test circuit will be open between single contact and contact piece in the line jack and all of its multiples, and the failure of the lamp to light indicates that the line tested is free for use.

THE SWITCH PLUGS.

The two plugs, Figs. 8 and 9, are made in two colors, all those to which the head 'phone circuit is connected being of one color and designated as the "first plug" of the pair, and all the plugs to which the magneto-generator circuit is connected being of another color and designated as the "second plug" of the pair. The circuit for the head 'phone and the magneto-generator, respectively, are normally open in the caps of their respective plugs between the cylindrical bushing in the cap and the conducting body of the plug. When a subscriber calls the central office, the force necessary to insert the plug in that subscriber's jack telescopes the cap, C, on the body, B, of the plug, closing the contact between the cylindrical bushing of the cap and the conducting body of the plug.

The release of the plug by the operator cuts out the head-'phone circuit of the ringing circuit, as the case may be, by means of the spring which forces the cap back to its normal position, thus breaking the contact between cylindrical bushing of the cap and conducting body of the plug. Either of these circuits can, however, be instantly re-established by a pressure of the operator's finger upon the cap of either plug; but should it become necessary to ring the calling subscriber or speak to the called subscriber the plugs must be reversed. In other words, all talking or listening must be done by the operator by means of the first plug of the pair, and all ringing by means of the second plug of the pair. The simplicity, speed and certainty secured by this arrangement will be readily appreciated.

THE LINE JACKS.

Fig. 10 illustrates the line jacks used in this system. It will be observed that the insertion of the plugs in the line jacks not only breaks the call circuits, but it also completes the circuit of the magnets which restore the armature to its original position, thus cutting out the circuit of the lamp. The circuit of these magnets is completed through the contacts and the metallic cap on the tip of the plug.

The purpose of opening the call circuit by the insertion of the plug in the line jack is not merely for the prevention of short circuiting or leakage of the talking current, but is for the very essential purpose of disestablishing the connection between the line and the main battery, B. The heavy current from this battery must be removed from the talking circuit, because if it be present conversation would be practically impossible.

ARRANGEMENT OF THE SWITCHBOARD.

The relative positions of the various details of the switchboard are shown in Figs. 11 and 12, which represent it in front

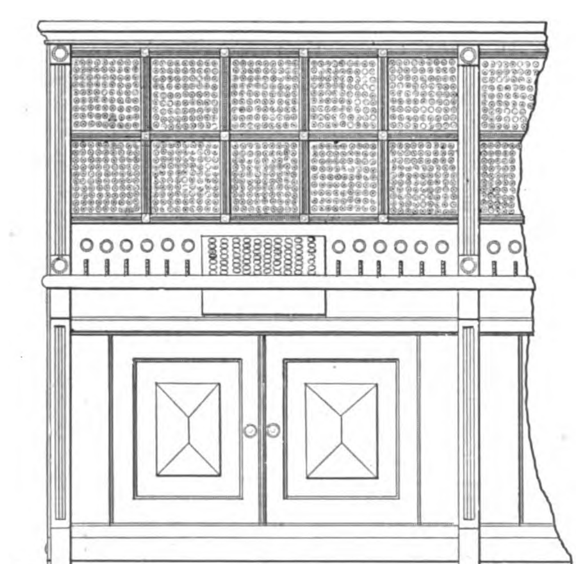


FIG. 11.—SWITCHBOARD.—FRONT VIEW.

and side view, respectively. It will be seen that the annunciators are placed at an angle on the apron of the switchboard below all the jacks, the relays operating them being racked up underneath the rear of the board. 100 annunciators occupying a space on the apron of the board less than twelve inches square. All the space above is thus left for jacks, it being possible to place a much larger number of subscribers in front of each operator, and also to add to the capacity of the board at

any time without reconstructing the portion already built. Such a board secures not only silence, but, it is claimed, a speed superior to anything heretofore attained, and adds greatly to the convenience of both the subscriber and operator. For example, if the former desires to speak to the operator, instead of hanging up his hand telephone on a gravity switch or operating the switch with one hand and the magneto in his box with the other hand, he simply presses the switch in his telephone handle several times in quick succession, thereby producing a series of flashes from the lamp which the operator instantly sees and answers.

The exchange is equipped with storage batteries, Crocker-Wheeler motor-dynamo chargers, Holtzer-Cabot direct and alternating motor-generators, reserve power generators, lamp resistance charging boards, etc., everywhere being in duplicate and in many cases triplicate, so that a complete breakdown is impossible.

THE COMPANY AND ITS BUSINESS.

One year ago Mobile, Ala., had only 300 subscribers to the old exchange. Their rates ranged from $50 to $150 per annum. To-day the Home Telephone Company has 800 subscribers, with

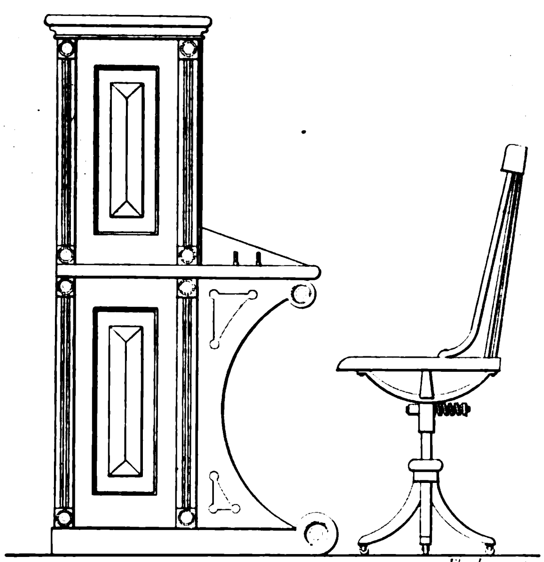


Fig. 12.—Switchboard.—Side View.

a prospect of 1,000 before they complete their construction. Their rates are $20 to $30 per annum.

The plant was constructed and installed under the personal supervision of Mr. Paul Minnis and the construction committee, composed of Messrs. Adam Glass, chairman; A. S. Lyons and W. H. Fitzpatrick, and is pronounced by experts to be the finest telephone plant in the South and one of the finest "overhead" plants in the country.

The officers and directors of the Home Telephone Company are: A. S. Lyons, president; J. K. Glennon, vice-president; Adam Glass, treasurer; W. H. Fitzpatrick, secretary; Henry Piser, A. H. Spira, P. J. Lyons, A. S. Benn and O. F. Cawthon, directors.

Literature.

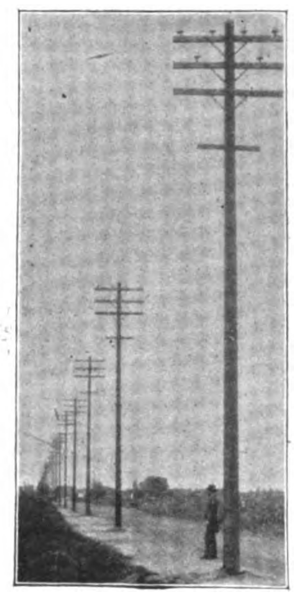
SYNOPSIS OF CURRENT ELECTRICAL LITERATURE, 1895, by Max Osterberg, E. E., A. M. New York, 1896: D. Van Nostrand Company. 143 pp., 7 x 10. Price $1.

This is an extremely useful and valuable publication, which we trust will be kept up. It contains an enormous quantity of well digested information and covers its ground thoroughly. There is little or nothing of importance that escapes Mr. Osterberg's dragnet, and the classification is remarkably good. Some of the more ephemeral items might perhaps have been dropped for the sake of more space on items of lasting utility, but, of course, it is difficult to get the real perspective from month to month. Mr. Osterberg indexes and digests here some fifty or sixty publications, so that even if his work had been done badly its mere bulk and scope would have given it a distinct value. The only trouble is there are now too many of these indexes; one really needs an index or synopsis of them. But Mr. Osterberg's work suffices for busy men and as a deposit of data should be supported by hearty encouragement.

Power Transmission.

THE 35-MILE ELECTRIC POWER TRANSMISSION AT FRESNO, CAL.

Fresno, the principal town of the great San Joaquin Valley, in California, was, during the last days of May, the scene of the completion of a great work, having for result the electrical transmission commercially over the longest distance yet attempted of power generated by an artificial fall of water unique in its creation and height.

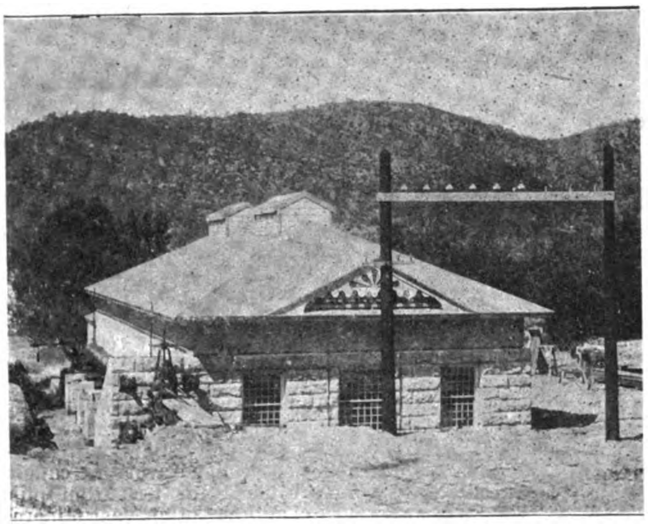


The city of Fresno stands in the valley of the San Joaquin River, in California, and was founded in 1872, when the Southern Pacific Railroad was first built in the valley. For thirteen years its growth was extremely slow, but in 1885 it received an impetus, and in the last ten years its population has risen to 15,000 persons. Its natural advantages are many: It is the center of a fertile agricultural region, overspread with a network of canals and ditches for irrigation purposes, and has other vast mineral resources as yet undeveloped. It is the commercial center of the San Joaquin Valley and would have become a manufacturing city had its aspirations in this direction not been subdued by the extremely high price of fuel and consequent heavy cost of power for manufacturing purposes. This handicap was felt severely by the city as a check upon its growth. All manufactured articles had to be purchased in the East, and when to their cost were added the

Pipe Line Descending Hill to Power House.

freight charges, prices on arrival at Fresno became almost prohibitive. The utilization of the difference of level of the San Joaquin River had been mooted, but not until the successful

solution of the problem of long distance power transmission had been reached did the utilization of the San Joaquin become possible. A company was formed, the San Joaquin Electric Company, to carry out the work, and the General Electric Company's project and three-phase system of transmission, by which power had already been successfully transmitted from Folsom to Sacramento, a distance of twenty-four miles, was adopted. The work, lacking a few details, is now complete and Fresno is on a par with any city of the East, so far as the cost of power and light is concerned.

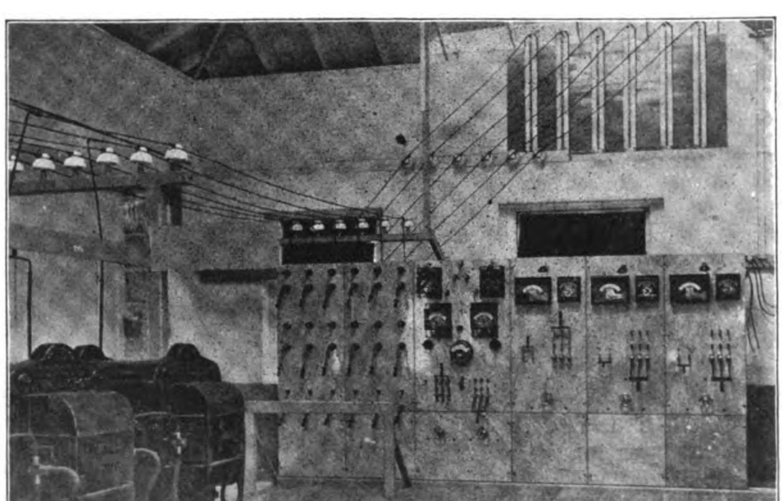


THE FRESNO ELECTRIC TRANSMISSION POWER HOUSE.

THE HYDRAULIC PLANT.

The source of the water power is the North Fork of the San Joaquin, which at the point of diversion runs through a narrow canyon with solid rock walls. The minimum low-water flow of the stream at this point is fifty cubic feet per second, which at the head used, will develop over 7,000 horse-power at the water wheels.

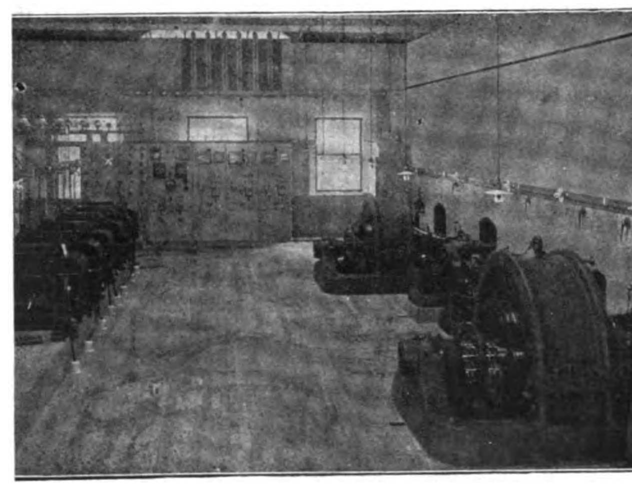
From the point of diversion, a flume has been built and a canal excavated and carried along the slopes of a hill for a distance of seven miles. They run along a right of way cleared of all obstructions for a width of 150 feet. The grade is 5.28 feet to the mile, and the lower bank forms a roadway for the inspection wagons. The entire system of headworks and canal is below frost line.



SWITCHBOARD IN FRESNO ELECTRIC TRANSMISSION POWER HOUSE.

At the end of the canal is a natural basin several acres in extent, surrounded for about three-quarters of its distance by a dyke of rock, which for an expenditure of less than $3,000 has been continued in an embankment for the remaining distance and a reservoir for storage water formed which at a maximum depth of only ten feet, will be sufficient to operate the plant at full load for several days consecutively. This provision will allow of the ditch and flume being shut off in case of repair or changes.

The reservoir is located at the top of a high hill, the river being some 1,600 feet below. From the pressure box in the reservoir the pipe line, 4,100 feet long, is brought down the mountain side and in this distance the difference in level between the water in the canal and the water in the river below is over 1,400 feet. For the first 400 feet the pipe is steel riveted; the balance is lap welded pipe, with lock joints, and at the lower end is ⅝ inch thick by 22 inches in diameter.



GENERATOR AND TRANSFORMER ROOM.

At the power house the pipe enters a receiver 57 feet long by 30 inches in diameter, of ¾-inch steel, with joints of the butt strap type. This receiver is designed to stand a working pressure of 800 lbs. to the square inch.

THE POWER HOUSE.

The power house at the bottom of the hill is built of native granite, with a wooden roof. It is 75 feet long by 30 feet wide and is built on solid bedrock. The receiver and water wheels are outside the main power house, the shafts passing through a heavy granite wall, which effectually keeps all water and moisture out of the dynamo room.

The water wheels are of the Pelton type, 57 inches in diameter, each capable of developing 500 horse-power at 600 revolutions per minute under an effective head of 1,410 feet, said to be the highest head ever used for power transmission purposes. The wheels are constructed with steel plate centers and bronze buckets and are fitted with flywheels, five feet in diameter. Separate wheels are provided for the exciters. The wheels which drive the generators are provided with Pelton differential governors.

THE ELECTRIC PLANT.

The electric plant consists of three General Electric three-phase generators, each of 350 kilowatts capacity, at a speed of 600 revolutions. The armatures are directly connected to the water wheels by insulated flange couplings. The exciters used are of the slow speed multipolar type. The current from the generators is delivered to six 125 kilowatt step-up transformers of the G. E. air blast type with secondaries wound for 11,200 volts, to which pressure the current in the transmission line is raised. Provision is left in the generator room for three more transformers of similar capacity. From the transformers the current passes to the switchboard, which is of Vermont marble highly polished, as are all the other switchboards used in the installation. The switchboard consists of six panels, three of which are generator panels, one exciter panel and the other two operate the combination of the six transformers and carry special high tension line switches.

THE TRANSMISSION LINE.

The 11,200-volt circuit, consisting of six bare copper wires, leaves the power house at the upper end, runs up the stream a few hundred feet, crosses the San Joaquin River, with a wide span of 275 feet, and is then led up the mountain for a distance of about 2,000 feet. The line continues for about ten miles through a rolling, hilly country, easy of access and at all times below the snow line; the rest of the line runs over a flat country and near Fresno passes through wheat fields and vineyards and follows a special right of way and wagon road for the entire distance.

The total length of the transmission line from the power house to the substation is little short of thirty-five miles, and is thus the longest commercial electric power transmission in the world.

The line is strung on special high-tension porcelain insulators made in the porcelain works of the General Electric Company, tested under 27,000 volts alternating before shipment. The poles are square redwood thirty-five feet long, set six feet into the ground and fitted with three heavy cross arms and one small cross arm for telephone wires. As a model of pole line construction, the Fresno transmission line can compare favorably with any pole line work done in the country.

THE SUBSTATION AT FRESNO.

The substation at Fresno is almost in the center of the business portion of the city, and is a brick structure 55 feet by 45 feet. The high pressure circuits entering the house are brought to nine step-down transformers, also of the air blast type. Three of these are 125 kilowatt capacity and reduce the pressure to 200 volts, three of 75 kilowatt capacity with secondaries of 1,000 volts, and three are of 40 kilowatt capacity, reducing the pressure to 3,000 volts. In addition to these transformers, the station also contains two 80-light Brush arc machines directly driven by two 60 horse-power, three-phase induction motors.

The system of distribution from the substation is divided up into three net works. The first a 200-volt, four-wire, low-tension network which covers the business portion of the town and having an initial capacity of 6,000 16 candle-power incandescent lamps. The second, a 1,000-volt, three-phase system, covering the residence districts of the town and having an initial capacity of 4,000 16 candle-power incandescent lamps. The third, a 3,000-volt, three-phase circuit designed to furnish current to the numerous vineyards and wineries within a radius of ten miles from the substation for both lighting and power purposes. Motors will also be furnished with current from both the 200-volt and 1,000-volt systems.

The policy of the operating company is of a broad gauge character, the end in view being the stimulation of the use of electric power. To effect this end prices are made which compare favorably with those charged for power where steam coal costs only $2 per ton. The result of this is that the demand has already taxed the resources of the company, although the plant has scarcely been running for one month.

THE UTILIZATION OF WATER POWER, ESPECIALLY WITH A SMALL FALL, WITH SOME EXAMPLES OF PLANTS FOR THE GENERATION OF ELECTRICAL ENERGY.—II.

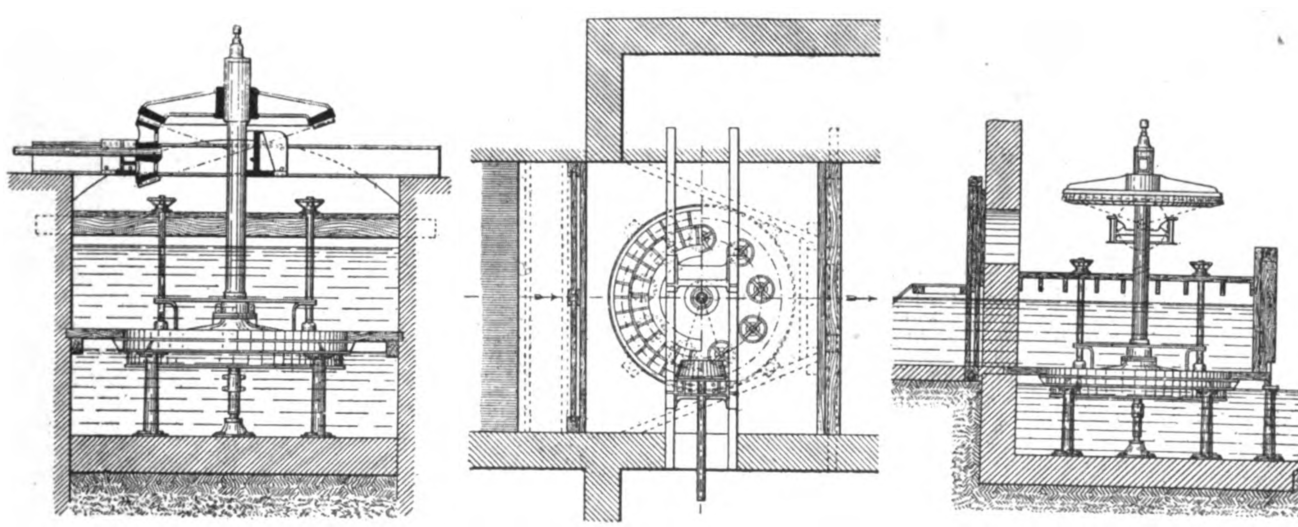
BY ALPH. STEIGER.

(*Concluded.*)

THE description of a Jonval turbine installation, which I supplied for the Brantham Mills, near Manningtree, in Essex, here illustrated, will show that a very small and varying fall can be utilized with great advantage to obtain nearly a constant power. The local conditions and requirements are most remarkable and interesting. The power is used to drive a modern flour mill, in which the maintenance of a regular speed is of equally great importance as for driving an electrical plant.

The River Stour is a tidal river, with a maximum fall at ebb tide of 4 feet 10 inches, while at high tide the fall is nil. The water is supplied partly by the river itself coming down from the hills of Cambridgeshire, and partly by the rising tide filling the river bed above the mill for a considerable length. The power required is 40 actual horse-power, and it was stipulated that this power should be maintained down to a fall of forty inches. On starting the turbine, it was shown, however, that it drove the mill at full capacity and at full speed under a fall reduced to thirty-two inches. The full power is available during sixteen hours of each day, while during six further hours the power corresponding to a fall reduced down to about one foot is still utilized for driving a part of the machinery. Comparing the useful power obtained from this varying fall by the new turbine during twenty-four hours with that obtained by the undershot water wheel previously working, it is nearly six times larger.

The turbine consists of only two concentric rows of buckets; the inner one is provided with gates, which are opened or closed by hand wheels, an automatic governor not being generally used in flour mills. The outer row of buckets is just large enough to give the full power required under the maximum fall. As the fall is decreasing by the rising tide, the gates of the inner row of buckets are gradually opened to make up the power by an increased quantity of water, and the more



FIGS. 5A, 5B AND 5C.—TURBINE AT BRANTHAM MILLS, ESSEX. CROSS SECTION, GROUND PLAN AND LONGITUDINAL SECTION.

water is passing through the buckets of the inner row, the more it acts on a reduced mean diameter, thus maintaining also the proper speed without perceptible loss of efficiency.[1] The power is transmitted from the turbine on to a horizontal main shaft by means of a pair of bevel wheels. This horizontal shaft is made to run at 75 revolutions, and is provided with a clutch by means of which the turbine is connected with the steam engine if the mill is required to work continuously. When the fall is reduced to more than thirty-two inches, the mill is, however, driven separately by the steam engine, and the power of the turbine is used to drive the wheat-cleaning machinery, and eventually some pairs of millstones which can work independent of the automatic roller mill plant. When the fall is reduced to fifteen inches, the power that is still obtained from this turbine is 7 horse-power, the turbine naturally running slower, but still this power is quite sufficient to be profitably utilized.

Assuming that the water power available at Brantham Mills

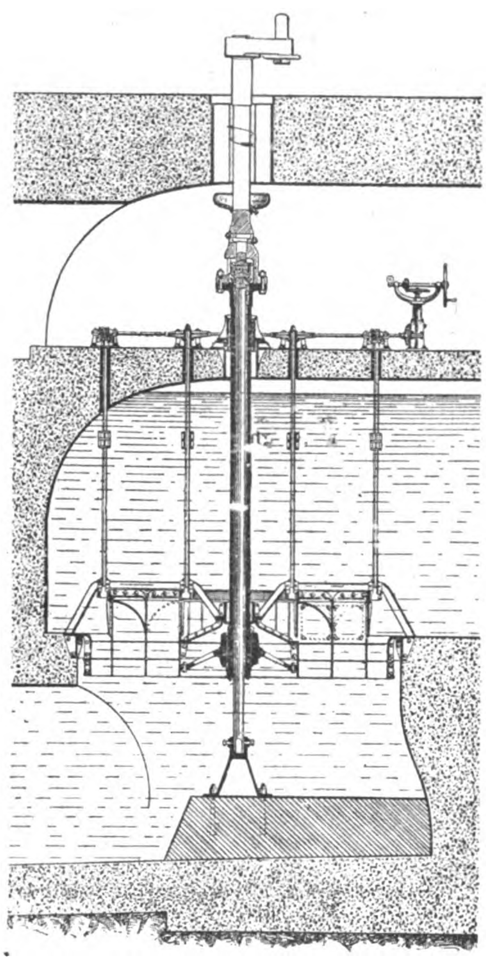


Fig. 6.—Turbines of the Waterworks, Geneva.

were applied for the generation of electric energy, it would, in the first instance, be necessary to obtain a conveniently high speed to drive an electrical generator without much intermediate gearing. A turbine similar to the one actually working could be made for exactly these conditions, running at thirty revolutions per minute, and a pair of bevel wheels put in of such proportions as to give the first motion shaft a speed of 150 revolutions per minute. This speed would be very suitable to drive a dynamo of 40 horse-power by means of a belt or ropes. A higher speed of the turbine than thirty revolutions would, for such a low fall, only be obtainable at the expense of efficiency. As in this special case the fall, and consequently the power, varies with the rise and fall of the tide, the full power of the turbine can of course only be relied on during fifteen or sixteen hours every day. The power produced during the time when the fall is diminished beyond the limit at which it is 40 horse-power, and at less than the normal speed, could probably be applied to charge electrical accumulators.

The construction of the turbine shaft deserves some notice. The space underneath the turbine being always filled with water, and, therefore, inaccessible, the pan for the footstep is placed on top of a column round which the hollow cast iron shaft revolves. The upper part of the turbine shaft is widened, and contains an adjustable steel pin which revolves in the pan or cup, filled with oil. Although a well-constructed footstep will last for years without requiring repairs, an easy access to it is of great advantage.

Similar turbines were erected by me in other mills near Norwich, Reading, and Lewes. In all cases the fall varies between two feet six inches and six feet, the reduction of the fall being caused by floods, while the water supply varies in the proportion of about 1 to 4. In each case the local conditions were carefully investigated and the turbine constructed accordingly. The good results obtained in each case are due to the careful adaptation of the turbine to the conditions. The importance of a careful consideration of local conditions is evidenced by several failures which were recently brought under my notice. In one of these instances, the turbine—which in itself is a very good motor—gives very poor results, owing to the disregard of the actual conditions of the locality. Even the construction of some details of a turbine depends sometimes on these conditions; and in several cases now under consideration I have had to depart from the general practice of designs of turbines, in order to secure the highest results when most required.

How varied the construction of a Jonval tube may be, will be shown by the following examples. The turbines of the Geneva waterworks, built by Messrs. Escher, Wyss & Co., of Zurich, work under a maximum fall of twelve feet during the winter season, when the water supply is shortest, while during the summer season the water supply stored up in the mountains, in the shape of snow and ice, is abundant. The large summer supply reduces the fall, however, to 5 feet 7 inches. The power of each turbine, of which there are now seventeen at work, is 210 actual horse-power, and they run at a uniform speed of thirty-six revolutions per minute, whether the fall is 5 feet 7 inches, or 12 feet. The cost in this case was a secondary question; the turbines have, therefore, been provided with the best possible arrangements to suit the large variations of the fall and quantity of water. The drawing shows three concentric rows of buckets. The outer row alone will develop 210 horse-power under the maximum fall of twelve feet—its outside diameter is fourteen feet. Each of the two inner rows of buckets is provided with a revolving gate, working separately. Each turbine drives a pair of double-acting plunger pumps direct, the crank common to both pumps being fixed on the vertical turbine shaft, Fig. 6.

An interesting turbine installation, under a fall varying from 10 feet 9 inches to 8 feet 10 inches, in connection with electrical generators, is that at Baden, in Switzerland. It was described in "Engineering" of November 1, 1895. This plant was erected to supply the town of Baden with electric light, and the necessary driving power to the new works of Messrs. Brown, Boveri & Co., the well-known electrical engineering firm. The fall had to be created by a weir, and a canal about 2,500 feet long, which added considerably to the cost of the plant. Each of the three turbines is of the Jonval type, giving off 200 British horse-power. It is impossible to build a turbine of that power for the fall available in this case, which would run with a speed high enough to drive a generator direct. The turbines run at forty revolutions per minute, which speed is maintained under the varying fall by means of gates for the inner row of buckets. The generators—two-phase dynamos of the horizontal type, made by Messrs. Brown, Boveri & Co.—run at 200 revolutions per minute, and are driven direct off the turbine shaft by means of a pair of bevel wheels. The exciter dynamos, of which there are three of 10 horse-power each, are driven each by a separate turbine. These small-power turbines naturally run at a higher speed—namely, 180 revolutions per minute—and drive, therefore, the exciter dynamos without any intermediate gearing.

In most cases in this country where a good water supply is available, the fall will be rather lower than 10 feet or 12 feet; it will therefore require intermediate gearing to drive a high-power generator, and it will even not often be possible to connect it direct with the first main shaft driven off the turbine by bevel wheels. Belt drives are very convenient to get up the necessary speed of dynamos, but for large power they are very expensive, and absorb a considerable amount of the power in friction. The ordinary round hemp and cotton rope is objectionable, on account of requiring frequent repairs and resplicing. During an inspecting tour in Switzerland last summer, I came across a new kind of hemp rope, which seems to supply just what is wanted to drive large power dynamos.

It is a plaited rope of extreme pliability, which does not stretch. I found this rope working at the generating station of Schaffhausen. The power at the generating station is transmitted from the countershafts, driven off two turbines of 300 horse-power each by means of bevel wheels, on to the gener-

[1] Outside diameter of this turbine is about 10 feet, and it runs at 24 revolutions per minute.

ators by means of ten such ropes, one and three-quarter inches thick. The rope pulleys on the dynamos have a diameter of five feet, running 300 revolutions per minute. The rope pulleys on the countershaft have a diameter of 13 feet 6 inches, and the distance between the centers of shafts is fifty-one feet. The power is electrically transmitted to a spinning mill about half

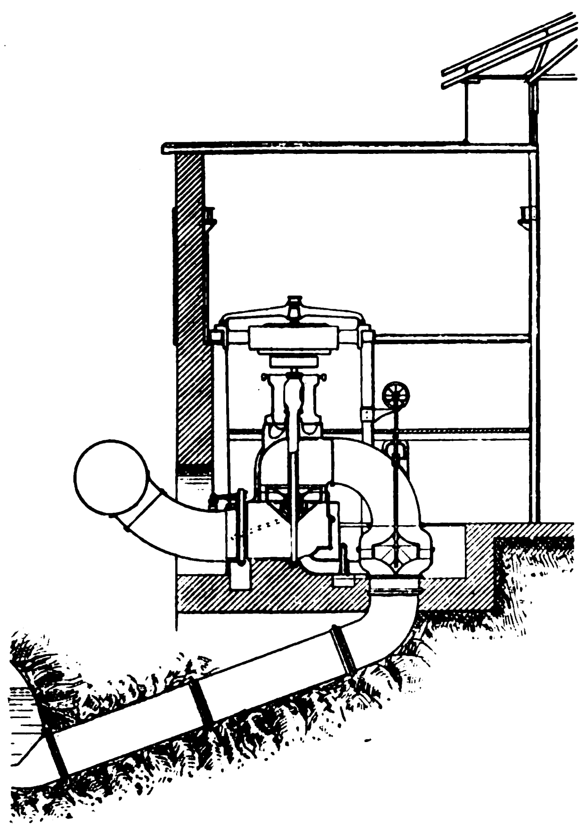


FIG. 7.—TURBINES OF THE ALUMINUM WORKS AT NEUHAUSEN, SWITZERLAND.

a mile distant from the generating station. The secondary station consists of an electromotor of 200 horse-power, coupled directly to a main line shaft, and two electromotors of 190 horse-power each, coupled together. The latter, running at 300 revolutions per minute, carry a rope pulley of five feet diameter with fourteen grooves. One hundred horse-power are transmitted by four such ropes to a shaft twenty-one feet above the electromotor, at an angle of 51 degrees, while the remaining 250 horse-power are transmitted to another shaft on about the same level and 17 feet 8 inches distant, running with 130 revolutions per minute. In spite of the unfavorable relative position of the shafts these ropes work with extreme regularity and easiness, and their adoption has, according to the manager of the spinning mill, put an end to the trouble and frequent stoppages caused by the breaking of the round ropes which were previously used.

Returning to the description of water-power plants proper, two more examples in connection with the generation of electricity deserve to be mentioned, showing how certain objects can be attained by a special construction. One of these is the installation of five new turbines for the aluminum works at Neuhausen, on the Rhine fall, in Switzerland. One of these turbines is here illustrated. Each of these turbines gives off 610 British horse-power under a fall of sixty-six feet, with a quantity of water of 6,500 cubic feet per minute. With the high fall a high speed suitable for driving the dynamo direct is naturally obtained—an arrangement which has also been adopted in this case to economize space. On the other hand, the load on the footstep of a turbine of the power mentioned by the pressure of the water, in addition to the weight of the armature of a generator of corresponding dimensions, is so great that a special arrangement had to be adopted to release the footstep of at least a part of that load. In order to overcome this difficulty, the turbine has been reversed, the water passing through the turbine upward, acting, therefore, in the opposite direction to the weight of the machinery. The boss of the turbine wheel is, moreover, formed into a piston, working in a cylinder, to which water under the pressure corresponding to the fall is admitted, thus counteracting again the weight of the moving parts of the turbine and dynamo. The water, after passing through the turbine, is conducted to the tail-race through a suction tube, the turbine being placed 15 feet 9 inches above the tail water. It runs at 150 revolutions per minute, and is a single Jonval turbine. To regulate its speed, if required, a ring gate is inserted in the suction tube, while it can be stopped by a throttle valve in the wrought iron tube taking the water to the turbine. The total power now utilized by these aluminum works is 4,550 horse-power. The turbines were constructed by Messrs. Escher, Wyss & Co., of Zurich, and the dynamos by the well-known electrical works at Oerlikon. Each dynamo is of 7,500 amperes and 55 volts.

The last turbine installation here illustrated is that at Zufikon-Bremgarten, also in Switzerland. The drawing shows another arrangement to counteract the weight carried by the footstep, and at the same time an arrangement by means of which the necessary speed to drive a dynamo of large power direct under a medium fall is obtained. The plant consists of four sets of double Jonval turbines of 325 British horse-power each, running at 115 revolutions per minute, and a smaller Jonval turbine of 34 British horse-power, driving two exciter dynamos, running with 210 revolutions per minute, and was erected to supply electric light to the neighboring town of Wohlen and driving power to the new works of Escher, Wyss & Co., in Zurich, and a large flour mill close by these works. The distance over which this power is transmitted is about eleven miles. The fall is 17 feet 6 inches, and was obtained by building a dam across the River Reuss, and a tunnel about 1,100 feet long across a hill round which the river flows at a rather high speed. The water is divided between two Jonval turbines fixed on one common shaft, so that it passes upward through the lower wheel and downward through the upper wheel. By distributing the water in this manner, the diameter of each turbine is reduced, and the speed consequently increased. At the same time the pressure of the water, which would otherwise act on the footstep, is entirely counterbalanced. The central part of the lower wheel, is, moreover, formed into a disc, on which the water presses from below, releasing the footstep also partly by the weight of the revolving parts of the turbine and the dynamo. The space between the two turbines on each shaft is connected with the tail-race by a flume formed

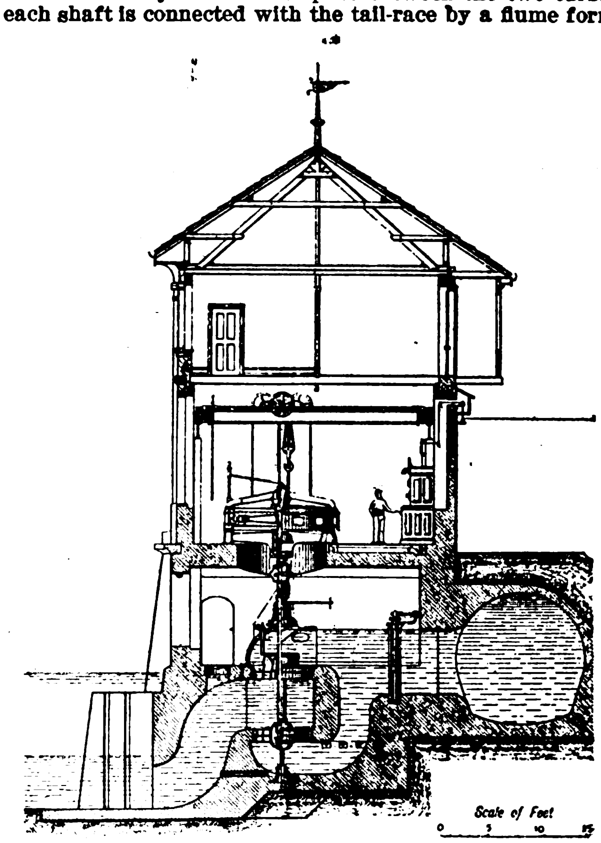


FIG. 8.—TURBINES AT ZUFIKON-BREMGARTEN, SWITZERLAND.

of concrete, which acts as a suction tube. This turbine plant was also erected by Messrs. Escher, Wyss & Co., and the dynamos were built by the Oerlikon works.

The examples given above of the utilization of water power may be considered as representative types of successful installations, under different conditions. They are sufficient in number and variety to prove the necessity of a selection from mo-

tors which are different in principle, and of the careful adaptation of the turbine selected to the local conditions and requirements.

A turbine installation under a low fall will be more costly than one under a higher fall; it is, consequently, of special importance to obtain the highest possible efficiency, even at an extra expense, under a low fall. The cost of the turbine itself is only a fraction of the total outlay for the plant, including foundations, connection with the machinery to be driven, and sometimes a weir and a canal. The cost of these permanent structures exceeds that of the motor; it is, therefore a penny wise and pound foolish policy, after putting in the permanent structure, to try and cut expenses by putting in a turbine of insufficient capacity or inferior efficiency. The commercial value of a water power depends rather more on the annual outlay on the same than on the first cost, and the annual outlay for the work obtained from the power is the smaller the higher the efficiency of the plant.

The efficiency of a turbine which can be obtained and honestly guaranteed, even if the fall is low, is about 75 per cent. Eighty per cent. and a little over is sometimes obtained under favorable conditions, and has been proved by careful tests made by responsible experts; but an efficiency of 85 and 90 per cent., sometimes claimed, is never reached, if the quantity of water be accurately measured during the test. If the efficiency of the turbine is guaranteed at all, it should be stated not only for the most favorable conditions, but also for a reasonable minimum of the fall or the quantity of water.

In many instances within my own knowledge, water power, in itself sufficient to drive the machinery of a factory, but improperly utilized, is supplemented by artificial power, produced by steam, gas, or oil engines. The loss of money caused by the waste of the cheap power from a running stream in this manner amounts certainly to a big sum in this country alone. The annual cost of such auxiliary power, calculated for 3,000 working hours, may be put at three to four times the cost of water power, and calculated for 6,000 working hours, four to eight times the cost of water power. A judicious utilization of the water power in such cases would not only result in an enormous saving of money, but in a gain of a large amount of power now unutilized. Most factories are closed at night time, when the water is allowed to run away without being made use of. Assuming that the water power is insufficient to drive all the machinery in the daytime, while it is wasted during the night, electrical storage batteries in connection with a generator might very advantageously, and perhaps with greater economy, be used instead of auxiliary steam, gas, or oil engines.

It seems probable that in the near future the electrical transmission of power will take the place of shafting and belt drives in factories, when certainly the waste of water power would be prevented in the manner suggested. Owners of factories driven by water power might even find that by improving their water power they obtain spare power which could be profitably applied by the generation and distribution of electrical energy in the immediate neighborhood. I may add that the majority of large-power central stations now being erected in Switzerland for the generation and distribution of electrical energy are mostly utilizing small or medium falls varying between 10 to 30 feet. The storage of water in the shape of snow and ice on our mountains provides us with a good water supply during the summer, but the low temperature in winter reduces that water supply very considerably. The water power there is just as variable as in other countries, and those falls which can be advantageously utilized on account of being situated in the inhabited and industrial districts are often not any higher, or not much higher, than in this country; the only difference being that such small falls occur more frequently, rendering a concentration of large power in one place easier, and perhaps less costly. Still, it is my conviction that concentration of water power for the distribution of electrical energy, or for the generation of a large amount of electric current, as required for electro-chemical and electro-metallurgical processes, is possible in many places in this country without going into prohibitive expenditure for canals, etc.

In conclusion, I hope to have succeeded in my endeavor to show how water power under low falls can be, and is, very advantageously and economically utilized for the generation of electrical energy; and that a very large amount of water power is now running to waste which could, in conjunction with electrical machinery and apparatus, be turned to profitable account by such a hearty co-operation of the electrical and the water-power engineer as has resulted in such success of commercial enterprise in my native country.

THE RAILROAD COMMISSIONERS of New York report that while in 1893 but 25 per cent. of the street railways in the State were electrically equipped, in 1895 about 94 per cent. were so equipped.

ROENTGEN RAYS.

ON THE BLEYER PHOTO-FLUOROSCOPE.[1]

BY J. MOUNT BLEYER, M. D., F. R. A. M. & of N.

SUFFICIENT of the practical value of the application of the Röntgen rays to medicine and surgery is already known for us to pronounce them, and the wonderful screen that reflects them, as among the greatest triumphs won in the modern history of discovery.

I am happy to say that after much experimenting in this field, I have been enabled to produce the photo-fluoroscope.[2] This invention enables the eye and the photographic sensitive plate to record simultaneously images as we are desirous of putting them on record.

The photography of luminous objects has been for some years an important factor in astronomical studies, as, for example, in the mapping of stars, and the recording of solar and stellar spectra and the phenomena of eclipse, but of late it has been made to embrace a broader range of subjects. Several of the most reputable photographers and scientists have of late given this special branch much thought and study; and among them I cannot pass by without mentioning a most beautiful set of pictures made by Wallace A. Levison and by Nikola Tesla, whose illustrations of luminous objects have given me much pleasure and fruitful recompense. I owe to the study of them the invention of the instantaneous fluoroscopic photography of luminous objects taken directly from the fluorescent screen.

The invention bears my name (Bleyer's photo-fluoroscope), and is very simple.

It is practically an adaptation of the fluoroscope to the needs

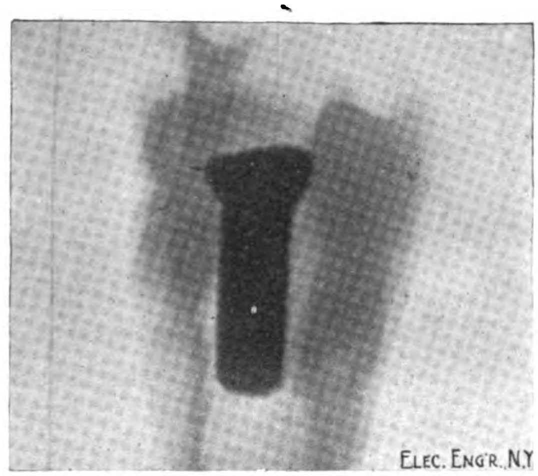


FIG. 1.—A PHOTO-FLUOROSCOPE PICTURE.

of the physician and surgeon, and consists in the combining of direct and instantaneous photography of the shadow thrown on the fluorescent screen. In other words, it is simply a combination of an ordinary copying photographing camera, and a fluoroscopic screen of special make carefully fitted into the camera. Several other types of camera can be adapted also for this purpose. The screen receives the object fully outlined in its detail, while the camera is so arranged as to take time exposure of the object made visible on the screen.

By this means the object can also be seen and studied and the trouble located before the photograph is taken. Then the proper focus is taken by means of the camera arrangements, and a direct photograph is obtained. The sensitive plate is then removed to the dark room and is there prepared like any other photograph.

The photo-fluoroscope has the advantage over other methods of revealing the object on the screen, either to be seen directly by the eye or to be reproduced on a sensitive plate. This renders it of peculiar advantage to physicians and surgeons for positive diagnosis. The photograph is necessary only for recording purposes, as the object can be seen plainly by the naked eye, the phosphorescence making it possible to see the

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[1]Original Communication to the Royal Academy of Medicine and Surgery of Naples, Italy, for 1896.

[2]I am indebted to Mr. A. A. Hamerschlag and to Mr. F. J. Harrison (editor of Anthony's "Photographic Bulletin") for most valuable suggestions during the progress of this investigation. The electrical apparatus employed by me is manufactured by A. A. Hamerschlag & Co., 26 Liberty street, New York.

object plainly in darkness. Necessarily, this is more advantageous to physicians than the general method of shadowgraphing by the ordinary plateholder, with the object placed thereon, without the assistance of the camera.

As far as we know at present in regard to the Röntgen rays, the laws applicable to light are entirely disobeyed, and consequently no lens or camera can be taken into consideration. This light does not admit of being, so to say, refracted or reflected in the same manner as ordinary light, so that there is no possibility of direct use of the camera with the Röntgen rays. But the onward march has added the fluorescent screen, by means of which the eye can follow the rays through hitherto impenetrable substances, and with its assistance I have succeeded in establishing the method illustrated, which for the use of physicians and surgeons is simpler and gives infinitely more satisfying results than any other method of which I know at present. The difficulty in accomplishing this can be appreciated only by those who have followed up the subject, and worked in the laboratory side by side with companions in the race for priority and with full knowledge of the thousands of difficulties that beset the endeavors of the experimenter.

One of the most important advantages that the photo-fluoroscope presents over the Röntgen method of photographing, is that curves, corners, and angles are no obstacle to it, while an object in the Röntgen photography must always be in direct contact on a flat plate containing the sensitized plate, the reason being that the Röntgen rays must be applied directly on the surface of the object, while with the photo-fluoroscope it may be taken at a short distance. This is due to the fact that the laws of light applicable to photography have been applied by photographing the luminous shadow from the screen and by the use of lenses.

To the left of the illustration, Fig. 2, is seen the camera fully equipped and its accessories mounted on a table, and its fluoroscope attached, showing on its screen a hand ready to be photographed by this process directly from its luminosity. The screen is arranged so that any size object can be taken in. The fluoroscopic box is very light, made of cardboard and fitted close on to the camera, encircling the lens with zinc, thus preventing stray Röntgen rays from reaching the sensitive plate through the wood portion of the camera. On the right side is a Crookes tube attached to a Ruhmkorff coil which is operated either by a spring break vibrator, or preferably by a wheel. The entire picture shows the full operation of photo-fluorographing. The latest model has many other detail attachments and advantages over this one.

Practical Points in Photographing by Means of the Photo-fluoroscope.—Above all things in photo-fluorography, a dark room is required for good results. Here the object to be photographed should first be located with the fluoroscope, in order to fix its exact position. This done, the screen on the photo-fluoroscope must light up the object until every detail shows clearly. Now shut off the X-rays before introducing the sensitive plate into the camera, to avoid any possibility of fogging the plate.

After these preliminary steps have been attended to the X-rays are turned on, and an exposure ranging from one to two minutes is allowed, depending upon the density of the object. Good strong X-rays are required, and it will be found that a coil giving a spark of from six to eight inches will answer all purposes for good ordinary work. In fact, all accessories should be in first-class working order; much experience is also necessary, and the best teacher, for obtaining good results by this method or by the Röntgen. A focus tube is the best.

The plates should not be removed until the X-rays have been shut off. Upon these few and simple injunctions depends the success of the photo-fluoroscope.

I succeeded as early as April 7 in locating a tube in the larynx, and another that had slipped down into the trachea, and recorded them, as shown in the accompanying picture, Fig. 1, in the early trials and undeveloped stages of my photo-fluoroscope, and before the Crookes tubes were brought up to standard make. I, nevertheless present them herein, knowing that they will create curiosity, and induce others to follow my footsteps in the use of the X-rays in laryngology.

In my lecture, April 15, 1896, before the Medico-Legal Society, I referred to this fact, notes of which were also published at the time. I refer to these dates now in confirmation of the priority of the objects located and photographed by me over those recently obtained by Dr. Levy, of Berlin, and others in England, and mistakenly accorded the priority in several of our dailies only.

At present much of my time and work with the photo-fluoroscope is being spent in shadowing out tumors, growths, foreign bodies, and various diseased conditions of the larynx and bones of the face and their accessory cavities, and the lungs with their many complicated ailments. In these experiments I have so far been very successful in obtaining first-class definitions of the varying shadows, illustrating many interesting clinical conditions of these organs. Many fine specimens which I made are in my possession, to which the above can testify.

The results of my further experiments will be taken up, with their technical points, in a later communication.

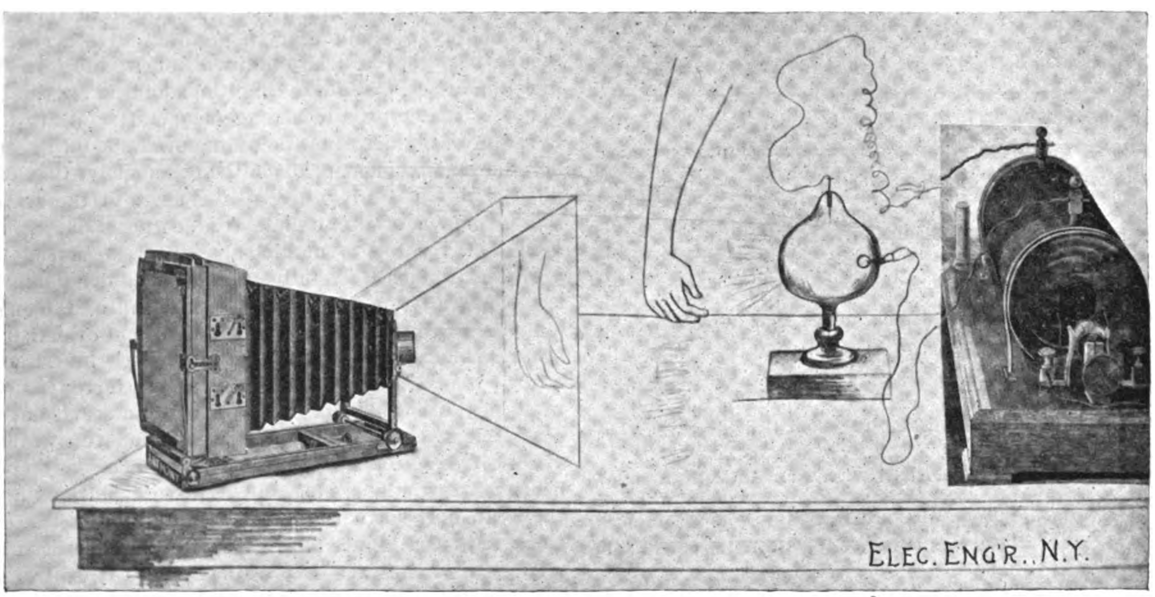

FIG. 2.—ARRANGEMENT OF THE BLEYER PHOTO-FLUOROSCOPE.

AN ELECTRIC RACE TIMER.

An electric chronograph, on which Professors Crehore and Austin have been working for some time, was put into operation recently in the races of the Interscholastic Association, of Boston.

The clock records the time from the report of the starting revolver to the breaking of the tape. Falling weights set in motion a heavy frictionless, rotating wheel. The record of time is made by a pencil on a roll of paper wound about the shaft cylinder. The explosion of the pistol releases the weights and sets the wheel in motion, and at the same time presses the lead on the paper. When the winner breaks the tape the circuit is made and broken, and the pencil point makes a notch in the record. The instrument is calibrated by an astronomical clock, the recorded revolutions all read by tables and the time deduced in seconds and fractions with the greatest possible accuracy.

THE
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CONTENTS.

MUNICIPAL OWNERSHIP OF ELECTRIC PLANTS.

During the recent meeting of the Street Lighting Convention in New Haven, there was considerable discussion on the subject of the municipal ownership of electric lighting and other plants which are operated under municipal franchises, and both the friends and opponents of government control were heard. The question has for some time been a burning one in this country, and almost every time a community becomes dissatisfied with its lighting service, municipal control is suggested by its adherents, as the only remedy for securing a perfectly satisfactory service at a minimum price. In opposition to this view Mr. Allen R. Foote discussed the subject in a very able paper read at the convention, in which he analyzes the situation as it presents itself in relation to electric lighting. It is difficult to find any convincing arguments or data favoring the municipal ownership of electric lighting or any other industrial enterprises, and if we look to the experiences of a number of cities where municipal lighting has been attempted the conviction that business undertakings are properly matters of private enterprise will be considerably strengthened.

Starting from the standpoint that the best interests of any municipality demand that its lighting or other service shall be the best that can be obtained and at the lowest cost, the question arises, Can these conditions be best obtained under policital or under private management? It appears too obvious to require argument that no public need should be supplied under the management of a political monopoly, that can be supplied with equal advantage to the users of the service, under the management of an industrial corporation. Much of the opinion favorable to municipal control is caused by a very prevalent but entirely unjustifiable prejudice against corporations generally, and this prejudice has caused the enactment of many laws governing the management and direction of corporations, which, to some extent, render such investments uncertain or unprofitable, except at a largely increased cost to the users of the service. In order to supply a service at the lowest cost it is necessary that the corporation furnishing the service be free as far as possible from unnecessary obstructions, charges, restrictions, etc., and if these conditions are imposed they can only have the effect of maintaining the cost to the consumers at a higher figure than it otherwise need be.

In spite of the fact that we have a great deal of restrictive legislation against corporations, which thus increases the cost of their services, the fact remains that in most cases where private and municipal services have come into competition the private corporations are generally more successful, both as to the cheapness of the service and the profits to the stockholders. When a municipality invests in a plant for carrying on any business it must secure the necessary funds by selling bonds. In the case of an electric plant for the distribution of light, heat and power for both public and private uses, if the charges for service are made high enough to produce a profit, this profit increases the cost to the consumers of the service for the benefit of those tax payers who are not consumers, and who may even be non-residents. On the other hand, if no profits are produced, then the non-users pay a certain amount of extra taxes for the benefit of those who use the service. It is also a generally acknowledged fact that money obtained by taxation is never expended by municipal politicians as economically as are the funds invested in private enterprises by the parties who have been obliged to earn their capital and who feel the necessity of disbursing it cautiously. Aside from the theory that commercial enterprises of this nature belong properly to the sphere of the private manufacturer or the merchant, experience has shown in a large number of cases that cities that have taken the action of purchasing electric light plants have, instead of gaining any advantage either as to the improvement of their lighting or the cost of the same, taken a step backward, and after a few years of presumably fair trial under municipal management a number of cities have found it to be their

best policy to sell out their municipal plants and allow the business to revert to private management. Among the cities that have passed through this experience are Greenville, S. C., Carrolton, Ga., Stockton, Kan., Lyons, Ia., Marceline, Mo., Marietta, O., Michigan City, Ind., Portland, Ore., Tipton, Ia.; Titusville, Pa., and Moline, Ill. The city of Chicago furnishes an example of the cost of electric lighting under municipal management. The cost per arc lamp per year was found after careful study to be $153.48, exclusive of taxes and insurance. A test of the value of this plant to the city lies in the fact that private companies are ready to contract to furnish the same amount of lighting at considerably less cost to the city than it can produce them for from its own plant. Another municipal plant which has been prominently mentioned as an example of the benefits of municipal ownership is that of the city of Detroit, Mich. In this case the plant was estimated to cost $600,000, and the cost per lamp per year was figured at $84. In addition to the issue of $600,000 of city bonds, $50,000 additional was required to be raised by direct taxation to complete the plant, and the annual cost per lamp already reaches $100 with a new plant in perfect order. Only 5 per cent. depreciation per annum is included in this cost and this we certainly know to be too small a figure. As the plant grows older the renewals will constantly increase the price per lamp, which already has been found to be higher than what private companies are charging in many places.

It is generally necessary to make considerable allowance in the figures quoted as the cost of lighting by municipal plants, as several items which should be included are frequently omitted by political financiers. One of these, just mentioned, is the depreciation, which should be fully included in estimating the cost of operation. This is just as necessary to include as the cost of coal, and if omitted at first, to make a brilliant showing of economy for the plant, must nevertheless be paid for eventually. In comparing the cost of city and private lighting the item of taxes is entirely neglected, though without reason. If the municipal plant were to be operated by a private company the cost of lighting to the city would be reduced by the amount that company would be obliged to pay over to the city in taxes.

Through improvement in machinery and by competition which naturally takes place in any commercial business the cost of lighting has been gradually reduced during the last ten years to less than half the original figure in many cases. In the city of New Haven the price per lamp was at first $237.25, while at present it is only $98.55, and this latter figure is considerably lower than can be found in the case of almost any municipal plant in the country. A number of these plants quote lower figures than this, some of them claiming the cost to be as low as $40 or $50 per year; but in every case where these phenominally low estimates are given, some important items of the real cost are invariably omitted.

Mr. Foote maintains that there is not a municipally-owned gas or electric light plant in the United States which private capital will not be willing to take over and operate under contract at the same price the service is now costing the municipality, all items of cost being correctly and fully considered and all franchise rights enjoyed by the municipality being assigned to the private corporation. This being the case, it shows that the general feeling among capitalists is, that there is always room for earning a profit by economizing the management of municipal plants. From the number of public plants which have already reverted to private ownership it seems probable that this will be the ultimate outcome of the majority of such plants after the cities have had sufficient experience in the line of municipal management.

ROENTGEN RAY WORK.

THE Röntgen X-ray still continues to be the subject of research and speculation among physicists, and, though much has been added to the general literature on the subject, it stands to the credit of Professor Röntgen that comparatively little has been added to our knowledge beyond what was contained in the discoverer's first announcement, and, again, that subsequent investigators have only confirmed the truth of his deductions. The search for the best methods and apparatus for producing the rays has resulted in several types of tubes, each one having its peculiar advantages. A recent practical development, specially worthy of notice, is the photo-fluoroscope of Dr. J. Mount Bleyer, which the inventor describes in another page. By its use the value of the fluoroscope cannot fail to be largely extended and work accomplished which was heretofore impracticable.

REVIVAL OF THE THIRD RAIL.

THE details of electric railway operation have now been pretty thoroughly worked out, and it would almost seem as if little more could be accomplished as long as the present general methods employed remain in vogue. But it would be a grave mistake, we think, to cling to the idea that no great changes will be made in the near future, and more particularly that methods found successful in street railway work are to be necessarily closely copied in the broader suburban and interurban traffic which is rapidly developing, and in which category must be included the hanging over of steam roads to electric. The most recent striking example of this newer development in methods is the equipment of the Nantasket Beach branch of the New York, New Haven & Hartford Railroad, with the insulated third rail as a supply conductor.

This reversion to the very earliest form of electric railway current supply system must be considered as of more than ordinary significance from more than one point of view.

In the first place, it answers the criticism of the steam railway advocates, that an overhead system of supply for heavy traffic in order to stand the wear and tear which would be put upon it would be prohibitive in cost and otherwise introduce difficulties of such a nature as to make it troublesome to operate, if not entirely prohibitive on a large scale. No such objection, of course, can be urged against the third rail as such, and it remains now only to be seen whether the system will stand up in actual use.

The only question, apparently, which remains to be solved is that of insulation. On this point we are satisfied that if a pressure no greater than 500 volts be used the system will be found workable and that the loss by leakage even in wet weather will not reach a prohibitive point. We are encouraged in this belief by the results obtained with high potentials on long-distance transmission lines in this country and abroad. If it be urged that a wire not suspended in the air is not comparable to rails laid on insulators close to the ground, it may be said that the potential in electric railways fed from one source will be proportionately less, and hence the leakage coefficient reduced in like ratio.

Apropos of the introduction of the third rail it would seem that the hold which the trolley has maintained on street traffic is by no means as strong as it was some time ago. Whether this be due to the fact that patent litigation on the under-running trolley has caused uneasiness among railroad companies, or whether the overhead system has been found to possess peculiar troubles of its own, the fact remains that conduit railway systems, and latterly more particularly surface contact systems, have found much more favor in the eyes of railroad companies than for a long time past. This is probably also largely traceable to the vast improvements in these systems and their demonstrated fitness to accomplish what their inventors have claimed for them. We may, therefore, look for their early extended application. The more one contemplates the situation the stronger grows the conviction that the time will be very short, indeed, when the overhead trolley will disappear in all of our large cities, and with it will begin a new era in the prosperity and stability of the electric railway, both as a system of transportation and as an investment.

Electric Transportation.

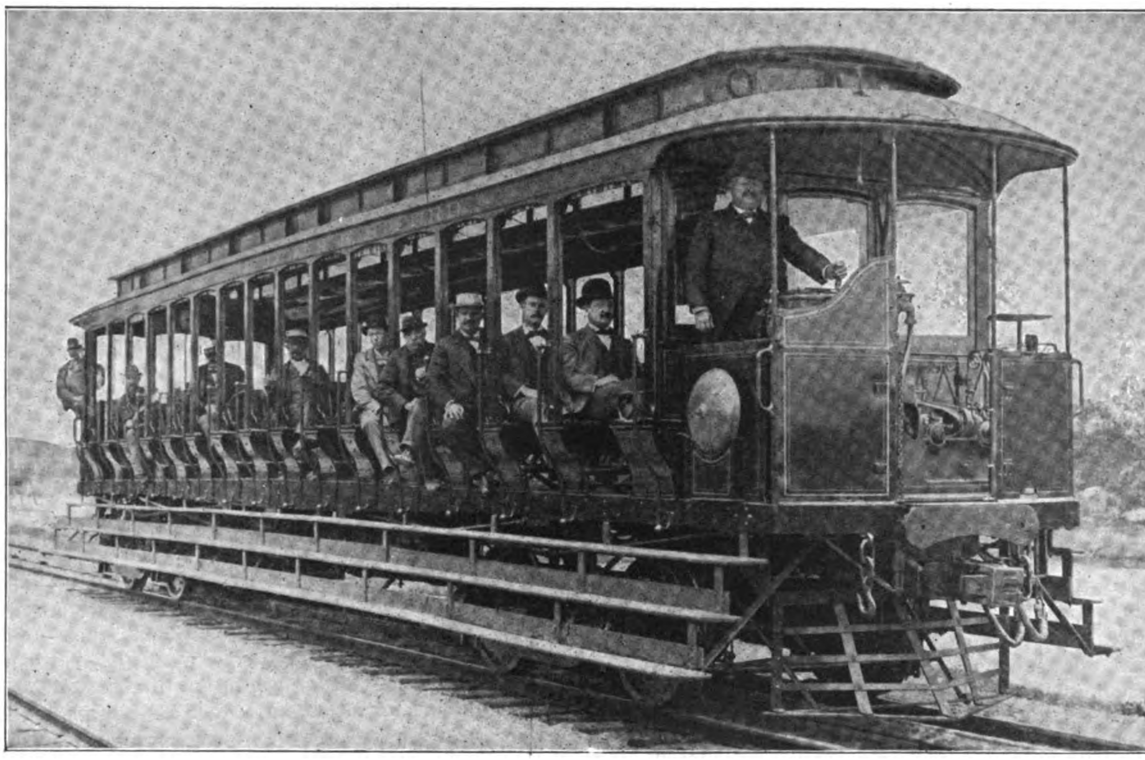
THIRD RAIL ON THE NANTASKET BEACH ROAD.

THE second step toward the operation of its main lines by electricity was made June 26 by the New York, New Haven & Hartford Railroad Company in the extension of the electrical equipment of the Nantasket Beach line as far as East Weymouth, 3½ miles along the main line of the South Shore Branch of the Plymouth Division, of which Mr. J. C. Sanborn is Superintendent.

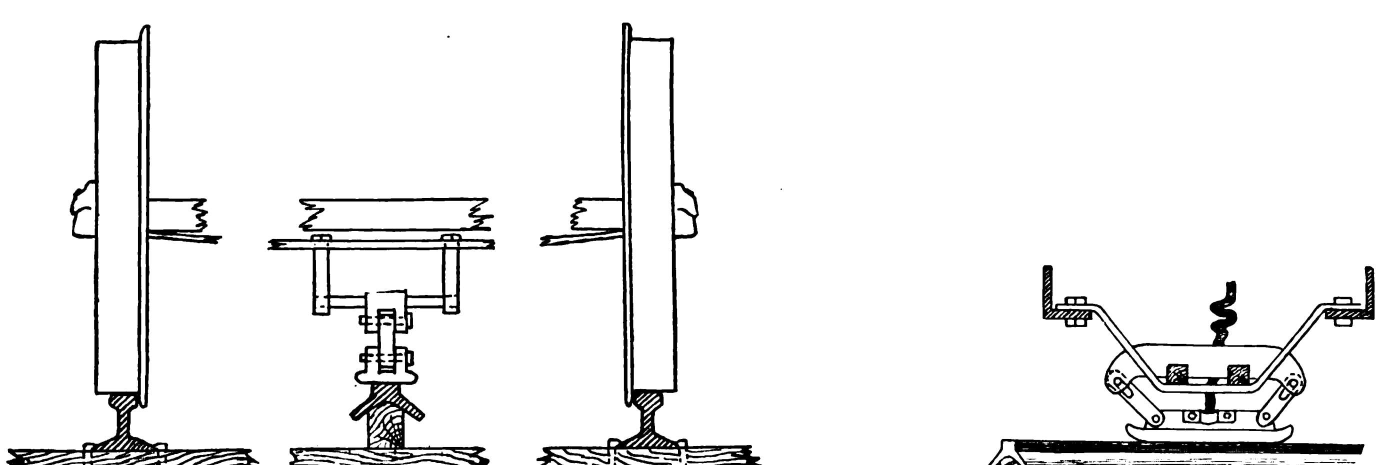
In determining upon this extension the overhead trolley system in use on the Nantasket Beach Branch was abandoned and the third rail method of contact chosen as the most readily adaptable to ordinary railroad requirements. While the third rail system for electric roads is not new, it being in use on the West Side and Lake Street Elevated Railways in Chicago, the rail being set outside the track, this is the first instance of a third rail being laid upon the permanent way of a trunk steam road, between the rails of the service track.

The current for the third rail section is brought from Power House No. 1, on the Nantasket Line, over two insulated feeders of copper cable laid along the tops of the poles which carry the overhead wires of the Nantasket Line. At the Nantasket Junction station the feeders are dropped to the ground, and each is connected to its own third rail.

The third rail is of peculiar shape—the end view resembling a flattened A, Fig. 1. It is laid midway between the two service rails of each track. Each section of third rail is 30 feet long, and weighs 93 pounds to the yard. It is supported by three ash blocks to each section, the blocks being let into the ties. Before use these blocks are boiled in vacuum pans with a tar compound, and thus each pore is filled with insulating and preservative material. The insulation is almost perfect. The continuity of the third rail circuit is secured by attaching each end of one rail to that of the next by means of two heavy copper bonds. The line between Nantasket Junction and East Weymouth is absolutely distinct electrically from that between the first-named stations and Pemberton. It is fed by its own feeders and is provided with its own automatic safety appliance which, in case of carelessness or accident to the third-rail section, enter into action and cut all current off from it, rendering it nothing more than a peculiarly laid stretch of track.



Electric Car on Nantasket Beach Railroad, with Third Rail Conductor.



Figs. 1 and 2.—View of Third Rail Conductor and Contact Shoe, Nantasket Beach R.R.

The electricity is taken from the third rail by two sliding shoes, Fig. 2, hung loosely from the car, one suspended between the axles of each truck immediately under the king pin by two links which allow it to slide easily over the top of the third rail and make perfect contact with it all the time. The current is brought to the motors through the controllers ond circuit breakers, and returns to the track rails by the wheels. The continuity of the return circuit is secured by using a short, thick bond of copper cable to join together the ends of each pair of track rails, the ends of the bond being fastened into the flange of the rail. The distance between each of the two shoes on the car is 33 feet. No third rail is laid at the crossings, the circuit continuing between the broken end by means of lead-covered cables. At the crossings, less than 30 feet wide, one of the shoes is always in contact; at wider ones the inertia of the moving car brings the shoes into contact again before the car can come to rest.

The baggage cars in use last year, each equipped with four motors, have been abandoned, and the large sixteen-bench open cars are alone employed as motor cars or locomotives. Sixteen of these cars will be put into service, each equipped with two General Electric "2,000" motors, two series parallel controllers, two automatic circuit breakers—the safeguards from accident to the rest of the electrical apparatus—and an air-pump and motor for the compressed air for the whistle and brakes. The air-pump combination is automatic in its action. As soon as the pressure in the main air-tank falls below ninety pounds to the square inch a small knife switch is closed by a spring and the motor starts. The switch is forced open by the air pressure as soon as that in the tank reaches the normal.

The cars leave Pemberton and run with the trolleys as far as Nantasket Junction. The trolley is then pulled down and hooked and the shoe strikes the third rail, the passengers being unaware of the change in the method of contact. The regular schedule of the electric trains between Pemberton and East Weymouth has been in force since June 14, but owing to the non-completion of the third-rail section the trains have been hauled from Nantasket Junction to East Weymouth, 3½ miles, by two steam locomotives.

A good idea of the advantage of electricity as a motive power compared with steam may be gathered from the fact that the two locomotives burn each four tons of coal per day, while not more than four tons per day burned in the power house serves to generate sufficient power to operate the whole seven miles of line between Pemberton and Nantasket Junction by electricity. The construction of the new section has been carried out under the personal supervision of Col. H. H. Heft.

During a recent test with the officials of the railroad on board, a speed of from 70 to 80 miles an hour was attained. On arrival at East Weymouth, the car was switched over and the return trip was made from East Weymouth to Pemberton in about eleven minutes, the distance being about 10½ miles. Should the operation of this road prove successful it is probable that the third-rail system will be extended as far as Braintree, a station 10 miles out of Boston, and if the success of the new method under the ordinary conditions of constant travel, fulfills all expectations, suburban service throughout the country will probably undergo a change.

HENRY'S RESISTANCE DETECTOR FOR RAIL JOINTS.

THE object of this instrument, invented by Mr. John C. Henry, of Denver, Col., is to make an examination as to the conductivity of the joints connecting the track rails. Heretofore the only method of testing the bonds when any trouble occurred was to open the pavement and replace all the bonds, both good and bad.

By the Henry method an electrician, with the assistance of a couple of boys, is enabled to examine the condition of the

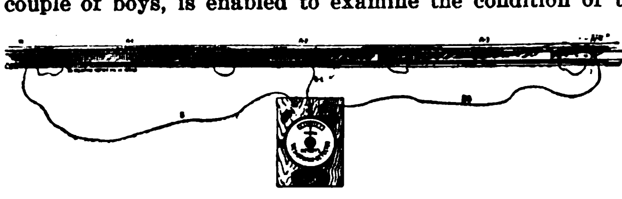


FIG. 1.—HENRY'S RESISTANCE DETECTOR.

joints on several miles of road in a day, and can mark the defective ones for repairs. The theory on which the method works is as follows: The instrument, Fig. 2,, which is called a "resistance detector," is a specially designed differential ammeter, which is so arranged that opposing magnet coils influence the needle. Those coils are connected to the portable flexible conductors, B and B2, Fig. 1. The other terminals are laid to the track rail in a central position, through the flexible conductor B-1. The tests are made when the cars are running. A portion of the current from the track rails is shunted through the instrument. If the conductivity of the rails is alike on both sides of the instrument the needle will

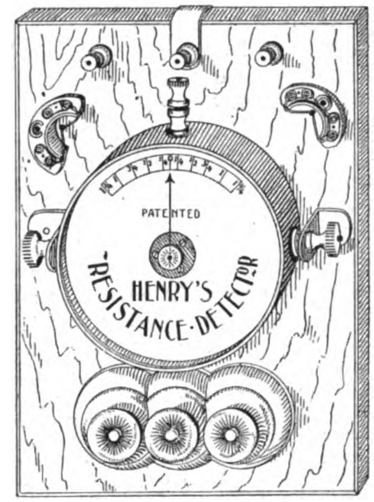


FIG. 2.—HENRY'S RESISTANCE DETECTOR.

stand at zero. Should there be a defect or a poor connection at the joint, A-4, for instance, more current will flow around that joint through the right hand coil of the instrument, and the lead, B-2. In consequence, the instrument becomes unbalanced and the pointer shows the direction of the cause. By closing in with the conductors, B and B-1, the bad joint can be located and marked for repairs.

THE AMERICAN STREET RAILWAY CONVENTION AT ST. LOUIS.

INDICATIONS are not wanting leading to the belief that the next convention of the American Street Railway Association to be held at St. Louis, Oct. 20, will be one of the best thus far held. The National Republican Convention Auditorium has been secured for the purpose, and our engraving

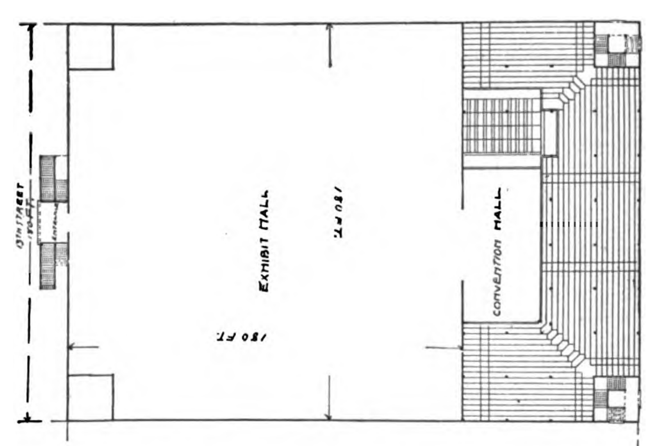


EXHIBIT HALL, STREET RAILWAY CONVENTION, ST. LOUIS.

shows the arrangement adopted. The exhibits will occupy a space 180 x 180 feet, thus giving ample room for the most elaborate displays of apparatus. The convention hall will be situated at the rear end of the building and will be completely separated from the exhibits. The entrance will be on Thirteenth street, so that delegates will pass through the exhibits before entering the convention hall.

"BREAD AND MEAT."

That standard sheet, known and read of all electrical men, The Electrical Engineer, is bread and meat to every station manager. Were he to lose it, his lights would go out.—"Kansas City Architect."

ELECTRIC LIGHTING.

CHARGING FOR CURRENT.

BY JOHN F. GILCHRIST, CHICAGO EDISON CO.

I have read the article on "Charging for Electric Lighting Service," in The Electrical Engineer of June 3, carefully and with great interest, as well as the editorial upon it, and am from my experience prepared to corroborate the statements made by Mr. Farnsworth and The Electrical Engineer as to the importance of some systematic basis of charge for electric current to customers of different classes, according to the quantity of light consumed and average consumption through a twenty-four-hour day.

My first impression in reading the article is that the writer does not lay much stress upon things which our experience has led us to believe are extremely important conditions, viz., the questions of business policy both as regarding quantity of light consumed and in competing with opposition companies. The conditions of the plant in which I have had my experience are also probably very different from conditions in the plants where there is in all probability the greatest amount of irregularity and poor judgment which Mr. Farnsworth intends particularly to reach. I realize it is rather narrow to criticise the honest suggestions of another without being able to offer suggestions borne out by good reasons as to a plan to be substituted. However, I will give a little outline of our method of dealing with these questions which may afford your readers some information on the subject under discussion.

In the first place, the system suggested would, it seems to me, be somewhat unsatisfactory in starting dealings with a customer, as the information necessary to classify the customer must be obtained from actual tests of the way the customer burns his light, and his average consumption as compared with the maximum capacity connected. This would, of course, require some little time, and it would be rather annoying to a business man and also prejudicial to the interests of the company not to be able to make some definite statements as to the exact charges before going into the matter. In addition to this, it is possible that many a customer would vary so in his consumption from month to month that he would be constantly changing from one class to another, and dispute would arise as to the class, which would necessitate intricate explanations as to methods which would be beyond the comprehension of many of the consumers, particularly in the large cities, and would, I believe, lead to dissatisfaction and suspicion.

The principal criticism I have to offer would be, that the cost of supervision necessary to keep the system properly enforced when established, without which it would be useless—would hardly be justified by the results obtained.

In our experience the cost of items included in class A, when figured out upon the basis of kilowatt capacity connected, is extremely small, so inconsiderable, in fact, that in the majority of cases a small minimum bill, such as the smallest consumer would not object to, would entirely cover it. Class B is not so easily disposed of, but as the great majority of consumers use current in much the same way, and during practically the same hours of the day, it seems to us the most practical to adopt a list basis of charge which would be fair for this class of customers, which may in this connection be the poorest class, and therefore entitled to the least consideration in the way of low price; and to take up separately the cases of consumers whose large consumption or consumption through a large portion of the day would entitle them to more consideration, and make discounts from the regular rate to these, which, in accordance with the business obtained viewed from every standpoint, would seem just. In this, as I have already stated, many times, in fact, in the majority of cases, questions of business policy with regard to certain customers would necessarily influence the company, and really in the long run represent as much to it as does the slight difference in the price of its product between the regular rate for that particular class of service and what it could get the business and hold it satisfactorily to the consumer for.

This method, while it seems beyond the reach of any system, is certainly not guesswork, as the conditions of each separate customer who is outside of the regular rule are taken into consideration, and the discount is made with due reference to the quantity of business actually assured either by minimum bill or agreement as to the use of electricity to the exclusion of other methods of illumination; to the relation of average to average maximum load and possibly extreme maximum load; to the hours of the day during which greater portion of current will be consumed; to duration of agreement, as tendency in all growing stations is to reduce cost of production, and to the effect which the use of current for illumination by a customer will have upon other prospective customers.

This arrangement covers all kinds of business, except, perhaps, cases which on any station will be few in number, viz., those that are glaringly unprofitable, such as emergency connections to the isolated plants, palatial residences or audience rooms which for purposes of large entertainments are equipped with enough lamp capacity to use several hundred times the normal amount of electricity, current being used in large quantities, however, only three or four times per year; and electric elevators of large capacity in apartment buildings where 80 per cent. of the work is done during two hours, morning and evening. These should be taken care of by a guarantee of a certain minimum income to the company, representing a fair interest on the company's investment necessarily maintained to furnish the customer with sufficient current to supply him at the maximum of his capacity or stipulation as to hours when use of current will be permitted, notification to be given the lighting company, or turning on of current to be controlled by them in some effective way.

Further than looking after all of its business in the above way, which, by the way, is a comparatively simple matter, to be certain that none of it is unprofitable, our company does not attempt to follow any absolute system, and as I state above, on account of the ever-increasing economy we rest secure in the assurance that any arrangement which is profitable at the time of making will be at least as profitable at any future time.

The question of difference of cost per kilowatt hour of output at different hours of the day, touched on in the article in The Electrical Engineer is attracting at the present time a great deal of attention, especially in direct-current stations, and many are experimenting with accumulators or watching with great interest the plants in which they are in practical operation, believing that they offer possibilities of greatly increased economy, by affording sufficient load to machinery throughout the entire day to admit of equally favorable operation at all times.

RULES OF THE PITTSBURG BOARD OF ELECTRICITY.

THE Bureau of Electricity of the Department of Public Safety, Pittsburg, Pa., has issued a circular letter to electrical contractors relating to an ordinance recently passed in that city. The ordinance provides for the appointment of electrical inspectors to overlook the construction and appliances used for electrical purposes.

Among the rules it is provided that hard drawn copper wire will not be approved and not more than six lights can be placed on any branch circuit, except by special permission. None but white porcelain insulators and bushings will be approved and all concealed work must be left open until examined by the inspectors.

MR. FALK'S X-RAY PICTURES.

We publish below an item appearing in the New Orleans "Times-Democrat," at the request of Mr. H. L. Falk, who asks it as a personal favor to him:

"New Orleans, June 15, 1896.

"To the Editor of the 'Times-Democrat:'

"This is to certify that we, the undersigned, have investigated and tested thoroughly Mr. Hilbert L. Falk's claim of being able to photograph the soft and hard tissues of the human body. With his special plates and screens, we have put him to the severest of tests, and we, the undersigned, do now hereby declare Mr. Falk's claim to be genuine in every respect. Hoping you will publish this, we are, very respectfully, (Signed) L. C. Ferell, Dr. J. M. Ferguson, J. A. Rehage, A. V. Fazende, T. P. Flaherty, Dr. F. Loeber."

We have no personal acquaintance with any of the above gentlemen, nor are they known to us by reputation.

PERSONAL.

PROFESSOR CHARLES W. CARMAN, of the Lewis Institute, Chicago, left on June 27 for Europe, on a tour of inspection preparatory to the equipping of the physical and electrical laboratories at the Lewis Institute. Professor Carman intends to visit the principal laboratories of England and the Continent.

MR. ALEX DOW, formerly city electrician of Detroit, has declined a reappointment to that office and accepted the position of manager of the Edison Illuminating Company, of Detroit.

NEWS AND NOTES.

THE KELVIN JUBILEE CELEBRATION.

As announced briefly in our last issue Lord Kelvin's jubilee was celebrated with much enthusiasm. The first public function took place on Monday, June 15, consisting of a conversazione in Bute Hall, at the Glasgow University. Over 2,000 persons gathered there in the evening and were received by Lord and Lady Kelvin. In the library there was an exhibition of Lord Kelvin's instruments, and here the Anglo-American Telegraph Company, the Commercial Cable Company, and the Eastern Telegraph Company received messages of congratulation to Lord Kelvin from all over the world, and sent the replies. A number of messages were also sent around the world. It was here that Lord Kelvin spent the greater part of the evening with much delight.

On Tuesday morning the presentation of addresses from the universities and scientific bodies took place. Among the large number of delegates who presented addresses were the following:

M. Lippmann, University of France; M. Henri Moissan, University of France; M. Picard, University of France; M. Mascart, Collège de France, who presented the Arago Medal of the Académie des Sciences to Lord Kelvin; M. Violle, Ecole Normale Supérieure; Professor Heinrich du Bois,University of Berlin; Professor Quincke, University of Heidelberg; Professor Woldemar Voigt, Royal Society of Science, Göttingen; Mr. T. C. Martin, American Institute of Electrical Engineers and National Electric Light Association, U. S. A.; Sir George G. Stokes and Professor J. J. Thomson, Cambridge; Professor Carey Foster and Sir Henry E. Roscoe, London; Professor Oliver J. Lodge, Victoria University; Professor Burdon Sanderson, Oxford; Professor Andrew Gray and Principal J. Viriamu Jones, University of Wales; Professor Stroud, Yorkshire College; Professor W. G. Adams, King's College; Professor Ramsay, University College; Professor Osborne Reynolds, Owens' College; Sir Frederick Abel, Society of Arts; Mr. A. A. Common, Royal Astronomical Society; Professor A. W. Rücker, British Association; Professor John M. Thomson, Chemical Society; Sir Benjamin Baker, Institution of Civil Engineers; Dr. John Hopkinson, Institution of Electrical Engineers; Major P. A. MacMahon, Mathematical Society; Captain W. de W. Abney, Physical Society; Sir Joseph Lister, Royal Society; Professor Schuster, Manchester Literary and Philosophical Society; Professor Silvanus Thompson, Finsbury Technical College, and Mr. H. A. C. Saunders, Eastern Brazilian Submarine, and Allied Cable Companies.

After the presentation of addresses the degree of Doctor of Laws was conferred on Lord Kelvin, who then conferred honorary degrees on a number of foreign scientists, among them Professor Cleveland Abbe, of Washington, and Professor Simon Newcomb, of Johns Hopkins University; Professor Lippmann, Professor Moissan, Professor Mascart, and Professor Quincke.

This ceremony was concluded by an address by Lord Kelvin, in which he thanked the university and the assembled guests for the honors showered upon him, concluding as follows:

"My fifty happy years of life and work as Professor of Natural Philosophy here, among my students and my colleagues of the university, and my many friends in the great city of Glasgow, call for gratitude; I cannot think of them without heartfelt gratitude. But now you heap coals of fire upon my head. You reward me for having enjoyed for fifty years the privilege of spending my time on the work most congenial to me and in the happiest of surroundings. You could not do more for me if I had spent my life in hardships and dangers, fighting for my country, or struggling to do good among the masses of our population, or working for the benefit of the people in public duty voluntarily accepted. I have had the honor to receive here to-day a gracious message from His Royal Highness the Prince of Wales and addresses from sister universities in all parts of the world; from learned societies, academies, associations, and institutions for the advancement of pure and applied science; from municipal corporations and other public bodies; from submarine telegraph companies, and from their officers, my old comrades in their work; from students, professors, and scientific workers of England, Scotland and Ireland, and other countries, including my revered and loved St. Peter's College, Cambridge, and my twenty Baltimore coefficients of 1884. The term coefficients is abused by mathematicians. They use it for one of the two factors of the result. To me the professor and his class of students are coefficient fellow-workers, each contributing to whatever can possibly be done by their daily meetings together. I dislike the term lecturer applied here. I prefer the French expression—"conférence." I feel that every meeting of a professor with his students is rather a conference than a pumping in of doctrine from the professor, perhaps ill understood and not well received by his students. The Scottish universities have enabled us to carry out this French idea of conference. I think in every one of his classes the professor is accustomed to speak to his student sometimes in the form of vivâ voce examination, and oftener, I hope, in the manner of interchange of thoughts, the professor discovering whether or not the student is following his lecture, and the student pointing out his own view on the subject, and helping the professor through his treatment of the subject. I have had addresses also from my old Japanese students of Glasgow University, now professors in the University of Tokio, or occupying posts in the Civil Service and Engineering Service of Japan. I wish particularly to thank my Baltimore coefficients for their address. They have been useful to myself in my own keen endeavor—unsuccessful, I must say—nevertheless keen—to find out something about—to know something about—light and ether and crystals. The addresses which I have received to-day contain liberal and friendly appreciation of all my published mathematical and physical papers, beginning in 1840, and ending—not yet, I hope. The small proportion of that long series of writings which has led to some definite advancement of science is amply credited for its results. The larger part, for which so much cannot be said, is treated with unfailing and sympathetic kindness as a record of persevering endeavor to see below the surface of matter. It has been carried on in the faith that the time is to come when much that is now dark in physical science shall be seen bright and clear, if not by ourselves, by our successors in the work. I am much gratified by the generous manner in which these addresses have referred to the practical applications of science in my work for submarine telegraphy; my contributions to the advancement of theoretical and practical knowledge of the tides; my improvements in the oldest and next oldest scientific aids to navigation, the sounding plummet and the mariner's compass, and my electric measuring instruments for scientific laboratories, for the observation of atmospheric electricity and for electrical engineering. I now ask the distinguished men who have honored me by presenting to me these addresses to accept for themselves personally, and for the societies represented by them, my warmest thanks for the great treasure which I have thus received—good-will, kindness, friendship, sympathy, encouragement for more work—a treasure of which no words can adequately describe the value. I thank all present in this great assembly for their kindness, which touches me deeply, and I thank the city and University of Glasgow for the crowning honor of my life which they have conferred on me by holding a commemoration of the jubilee of my professorship."

The festivities terminated with a banquet in St. Andrew's Hall, in which 600 guests took part, and in response to a toast Lord Kelvin made a brief address, in the course of which, he said:

"I might, perhaps, rightly feel pride in knowing that the University and City of Glasgow have joined in conferring on me the great honor of holding this jubilee, and that so many friends and so many distinguished men, friends and comrades—day laborers in science—have come from near and far to assist in its celebration, and that congratulations and good wishes have poured in on me by letter and telegram from all parts of the world. I do feel profoundly grateful. But when I think how infinitely little is all that I have done I cannot feel pride; I only see the great kindness of my scientific comrades, and of all my friends, in crediting me for so much. One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly during fifty-five years: that word is failure. I know no more of electric and magnetic force or of the relation between ether, electricity, and ponderable matter, or chemical affinity, than I knew and tried to teach to my students of natural philosophy fifty years ago in my first session as professor. Something of sadness must come of failure; but in the pursuit of science, inborn necessity to make the effort brings with it much of the certaminis gaudia, and saves the naturalist from being wholly miserable, perhaps, even allows him to be fairly happy, in his daily work. And what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these fifty years have so abounded! You, my Lord Provost, have remarked that I have had the good fortune to remain for fifty years in one post. I cordially reply that for me they have been happy years. I cannot forget that that happiness of Glasgow University, both for students and professors, is largely due to the friendly and genial city of Glasgow in the midst of which it lives. To live among friends

is the primary essential of happiness; and that, my memory tells me, we inhabitants of the university have enjoyed since I first came to live in it in 1832, sixty-four years ago!"

STEVENS INSTITUTE OF TECHNOLOGY.

At the commencement exercises of the graduating class of '96 from the Stevens Institute of Technology, Hoboken, N. J., held June 18, the degree of Doctor of Engineering was conferred upon Commodore George W. Melville, Engineer-in-Chief of the United States Navy, in appreciation of the excellent engineering work performed by Commodore Melville for his country and the advancement of the science of steam engineering, well illustrated in the famous "White Squadron."

Only once before in the twenty-five years' history of the Stevens Institute has the degree of Doctor of Engineering been conferred, and then upon Professor R. H. Thurston, who formerly occupied the chair of Mechanical Engineering in Stevens Institute, and is now director of Sibley College, Cornell University.

SOCIETY AND CLUB NOTES.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

The fifteenth annual convention of the Association of Railway Telegraph Superintendents was held at Hygeia Hotel, Fortress Monroe, Va., from June 17 to 20 inclusive. The meeting was well attended, many of the members being accompanied by their wives and daughters, whose presence added greatly to the social features of the convention.

After the transaction of the regular business and the reading of a number of papers the selection of a place for the next annual meeting was discussed. Niagara Falls was decided upon and the date was fixed for June 17, 1897.

The following officers were elected for the ensuing year: President, George M. Dugan, Superintendent Illinois Central Railroad, Chicago; vice-president, J. W. Lattig, Lehigh Valley Railroad, South Bethlehem, Pa.; secretary and treasurer, P. W. Drew, Wisconsin Central Railroad, Milwaukee, Wis.

MISCELLANEOUS.

ELECTRICITY DIRECT FROM CARBON.[1]

BY DR. ALFRED COEHN.

THE problem of the direct production of electricity from carbon would find its simplest solution if we could succeed in dissolving carbon in a fluid, just as we do metals. This question is formulated thus by the theory of electrolysis: Can carbon form ions?

In attempting to find an answer to this question, I started from an observation made by Bartoli and Papasogli, that when dilute sulphuric acid was electrolyzed between carbon electrodes, the carbon anode takes part in the electrolytic processes in such a way that, besides oxygen, both carbonic oxide and carbonic acid make their appearance at the anode. I commenced my experiments by varying the important factors, viz., concentration, temperature, and current density, in order to discover whether it was possible to obtain the products of combustion without admixture of oxygen on the anode. I have not succeeded in obtaining carbonic acid or carbonic oxide alone, but a mixture of the two, containing only 1 per cent. of oxygen. In this mixture about 70 per cent. was carbonic acid and 30 per cent. carbonic oxide.

In these experiments it was observed that at low temperatures a disintegration of the carbon anode took place, small particles of carbon being seen suspended in the acid. At higher temperatures, on the contrary, no such disintegration of the carbon took place, but a distinct coloration of the acid was produced—at first yellow, then later dark red and red brown. If this is a solution of the carbon brought about by the current, the carbon is presumably contained in it, in the form of ions, i. e., in a form capable of being influenced by the directing power of the current. Such a solution must be capable of giving up carbon to the cathode, since carbon does not decompose water. (A series of platinum plates, coated with carbon, was shown, and a dish, such as is used by Classen for quantitative electrolytic analysis, was shown coated inside with a dense layer of carbon.) The solution and precipitation could readily be obtained with different kinds of coal as anode. Ordinary coal ground smooth, and arc lamp carbons, were found specially suitable; the experiment also succeeded with coke.

That the precipitate was really carbon, and not metal derived from impurities in the coal, was shown by treatment with acids. It was not attacked by hydrochloric acid; in hot nitric acid traces were dissolved—as in the calorimetric test for carbon in steel. In the flame, even the densest precipitates completely disappeared immediately. Finally, a direct proof was obtained by oxidizing the precipitated carbon by chromic acid, and absorbing the resulting carbonic acid in alkali. A number of analyses were made, and these always showed, in addition to carbon, a little hydrogen. The residue—reckoned as oxygen—was sufficient to convert the hydrogen found into water. Either, therefore, in addition to the carbon, a solid, conducting carbohydrate was separated, or some kind of crystalline water which adhered strongly to the carbon was produced. The presence of water in the precipitate is indicated by its behavior with concentrated sulphuric acid. If the acid is dropped on the precipitate it is immediately loosened and blackened, reminding one of the behavior of sulphuric acid with a carbohydrate.

It was now of interest to attempt to construct an element whose soluble electrode consisted of carbon. The only question now was to place a more electro-negative element opposite the carbon. The peroxides stand still nearer even than carbon to the negative end of the potential series. Lead peroxide was used in the practical form of a charged accumulator plate. If this is placed opposite a carbon in sulphuric acid of the proper concentration, temperature, etc., an element is formed of which carbon is the soluble electrode. The element supplies a strong and constant current. Through an external resistance of 100 ohms it shows an e. m. f. of 1.03 volts.

There arises here the question whether any share in the production of the current is due to the reaction on the carbon, and if so, what share? Platinum also, when placed opposite a peroxide plate under the same conditions, shows a current in the same direction as the carbon. But it never comes to a visible development of oxygen; as soon as the platinum is charged with oxygen, the current becomes exceedingly small. If the carbon was an insoluble electrode, it would behave in the same way. But this is not the case. The current lasts till the accumulator plate is discharged. A second charged peroxide plate may then be substituted, and the current is again produced as strong as before.

The results of my investigation may be summarized as follows:

1. It is possible by electrolysis to produce a solution of carbon.
2. From such a solution, carbon may be separated as a cation.
3. An element may be formed of which carbon is the soluble electrode.

[1]Read before the Berlin Elektrot. Verein.

EFFECT OF TEMPERATURE ON INSULATING MATERIALS.[1]

BY CHAS. F. SCOTT.

IN the discussion of this paper, I referred to certain tests made by Mr. C. E. Skinner, who has kindly furnished the following statement of some results which he has obtained in his work in this line:

Some time ago a series of tests were undertaken to determine the effect of temperature on the insulation resistance and braking down e. m. f. of various insulating materials and of completed apparatus. A large number of insulating materials, including paper, cloth, etc., both in the treated and untreated forms, were tested.

(1) Tests on Insulating Materials.—Various methods of making these tests were tried. The apparatus illustrated in Fig. 1 was finally adopted for standard tests as being best suited for practical work. This piece of apparatus consists of two similar parts, the two parts forming the plates between which the insulating material is placed when tested. These plates are ten inches in diameter and are carefully surfaced. Each part is made of two separate pieces of castiron, fastened together, as shown, and wound with a coil of asbestos covered wire. The heating of the apparatus is effected by sending an alternating current through the two coils in series. The heating results from the eddy current and hysteresis loss in the iron as well as from the copper loss in the coil. The rate of heating can be controlled easily by means of a suitable rheostat in circuit with the coils, the mass of iron in the heater being sufficient to prevent sudden changes of temperature from outside causes. The

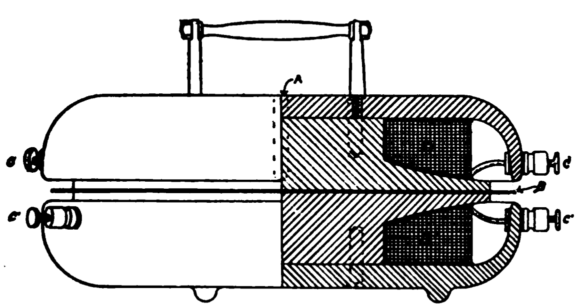
[1] Communicated after adjournment to the A. I. E. E.—Abstract.

insulation resistance of the samples was measured in all cases by means of a high resistance voltmeter on a 500-volt circuit, all wires of the heating circuit being disconnected when the insulation measurements were made.

A curve was obtained from tests on a piece of untreated paper. The minimum resistance was reached at slightly below 100 degrees C. From this point the resistance rises rapidly until it reaches a point too high to be measured with the apparatus used. The absolute value of the insulation resistance of any material of this class depends on the amount of moisture in the material at the start, the rate of heating and the chance for the escape of moisture during the test. The absolute value of the insulation resistance of treated material depends largely on the drying of the material before treatment. Samples of cloth which were treated with linseed oil after being thoroughly dried and then the oil baked on, do not at any time show a very low insulation resistance, even at a temperature of 150 degrees C.

A test of a sample of 0.15" calendered pressboard was maue as follows: The temperature was maintained constant at 120 degrees for thirty-one hours. At the end of this time the temperature was increased to 280 degrees. At the end of thirty minutes the insulation resistance had fallen from 85 megohms to less than one megohm and again risen to about 12 megohms. The lowest point reached was .032 megohm. At the end of seventy minutes the insulation resistance had become too great to be measured by the apparatus at hand. Frequent readings were taken during the thirty-one hours' run at 120 degrees C., but at no time was it possible to measure the insulation resistance.

(2) Tests on Completed Apparatus.—A curve was obtained from tests on a motor armature which was wound without previous drying of any of its insulating materials. The motor was run with an overload and measurements were made at frequent intervals. The temperature could not be taken until the end of the run, when it was found to be about 110 degrees



Apparatus for Testing Insulating Materials.

C. The drop in the curve at the points a and b is accounted for by the fact that the load was increased at these points, thus increasing the temperature of the armature. The lowest insulation resistance reached in this test was 4,500 ohms. At the end of seventy hours the insulation resistance on the armature had become so high that insulation resistance measurements could not be made.

(3) Relation Between Breaking Down E. M. F. and Insulation Resistance.—An attempt was made to establish the relation between the breaking down test of insulating materials and their insulation resistance. For this purpose samples of paper which gave a very uniform breaking down test in the normal state were heated up until the insulation resistance reached a certain predetermined amount, when the breaking down test was quickly made. It was found impossible to establish any definite relation between the two, even for a given material. It was found, however, that a low insulation resistance usually meant a low breaking down test, but a low breaking down test did not necessarily mean a low insulation resistance.

(4) Conclusions.—(a) The insulation resistance of all ordinary fibrous insulating materials, such as paper, cloth, etc., decreases upon being heated up and then increases again when the moisture is expelled.

(b) Continued heating of thirty-one hours at 120 degrees C. does not lower the insulation resistance of paper.

(c) The insulation resistance of completed apparatus shows the same characteristics as the insulation resistance of materials taken separately.

(d) A low insulation resistance is not necessarily an indication of poor insulation, but probably an indication of the condition of the apparatus in regard to moisture.

(e) A high e. m. f. should not be applied to apparatus when the insulation resistance is low.

(f) Material which is badly deteriorated mechanically by heat may still have a high insulation resistance, but very poor insulating qualities.

RIFLE BULLETS DEFLECTED BY ELECTRICITY.

A RECENT discovery seems to indicate that modern steel projectiles may be deflected from their course by means of electricity. It was noticed by the committee of the Federal Rifle Meeting at Winterthur, Switzerland, that the greatest number of hits on the target fired from the right side of the range were marked on the right of the bull's-eye, while those fired from the left of the range were almost exclusively on its left. Moreover, all projectiles partly or wholly constructed of steel had become magnetic. These facts suggested various theories, and among them it was suggested that the diversion of the bullets might be due to the numerous electric and telephone wires extending along both sides of the range at Winterthur. Fresh experiments at the ranges of Berne and Thun confirmed this conclusion.

At Thun there was used parallel with the rifle range, at a distance of a little more than forty yards, an electric current of 8,000 volts, carried along four steel cables. With a view of tracing the whole effect paper circlets were placed at every ten yards. The first experiments were made with the Swiss model rifle of 1889. With this the influence of the electric current was at once apparent. In a distance of 260 yards the bullet took a lateral deviation of twenty-four yards, and after that the curve of the trajectory was still more marked. The second experiments were made with the Japanese 3.3 mm. rifle of Colonel Yamagata, and they were still more decisive, the bullet being rapidly attracted to the electric wires and following their course. Further attempts were made with artillery. The range selected was one of 3,000 yards and 200 yards in front of the targets, but forty yards to the side, was placed the electric circuit. Every shot was diverted by its influence far to the side of the target. The deviation was one of 14 degrees.

THE COST OF WIRE.

In an address by Thomas Morris before the Staffordshire, England, iron and steel works' managers on the remarkable achievements that have been reached in the manufacture of fine wire, the interesting fact was mentioned that the lecturer had been presented by Warrington, the wire manufacturer, with specimens for which some $4.32 per lb. were obtained, or more than $8,600 per ton—drawn wire, largely used in the construction of piano and other musical and mechanical instruments. Among these specimens also was pinion wire, at a market price of $21.60 per lb., or $43,200 per ton—it took 754 hairsprings to weigh an ounce of 437½ grains. 27,000,000 of these were required to make a ton, and, taking one to be worth a cent and a half, the value of a ton of these cheap little things ran up to over $400,000. The barbed instrument used by dentists for extracting nerves from teeth was even more expensive, representing some $2,150,000 per ton.

THE HÆMOSTAT.

Demonstrations have been given lately by Mr. Lawson Tait, in London, of his electric hæmostat, an instrument which, as the name denotes, is intended for the arrest of bleeding in surgical operations. A platinum wire, arranged to carry a current, is inclosed in the blades of a pair of steel forceps, or any other requisite instrument, the wire being isolated by a bed of burnt pipeclay. A current of suitable voltage is turned on, the artery seized and compressed, and in a few seconds the tissues and arterial walls are so agglutinated that the passage of blood is rendered impossible. The temperature employed is about 180 degrees F., so that it will be seen that the principle is fundamentally different from that of electrical cauterizing instruments. It is stated that by Mr. Tait's instrument the necessity for a ligature is removed, and a new and completely effective method is placed in the hands of the surgeon for the treatment of surface oozing.

NEW OPEN CIRCUIT CELL.

A new cell is described in "L'Electricien," the main feature of which is the short distance between the plates. It is a carbon-zinc combination. The carbon is channelled down one side and filled in with a paste made of powdered carbon and manganese dioxide. The zinc plate is amalgamated in the usual way, but is only separated from the carbon by a piece of coarse felt of small thickness. The liquid is a solution of two parts by weight of sal-ammoniac to one part each of common salt and chloride of zinc. It is stated that a cell about 6½ inches high will give four amperes at 1.5 volts.

CONNECTING LIGHTHOUSES AND LIGHT SHIPS WITH THE SHORE.

THE fourth report has been submitted by the Royal Commission appointed to inquire into the question of connecting lighthouses and light ships with the telegraph system of the United Kingdom by electrical communication, for the purposes of reporting vessels in distress, casualties at sea and transmitting storm warnings. The following is an abstract of the report:

In the last report, issued in April, 1895, the hope was expressed that, after visiting Denmark and inspecting the system of electrical communication with lighthouses and life-saving stations in that country, the Commission would be in a position to prepare the way for their final report. In consequence, however, of the serious difficulties which continue to be experienced in maintaining electrical communication with certain light vessels on the system now employed, it has been decided to postpone the final report until attempts have been made by further experiments to overcome these difficulties.

Connections Which Have Been Effected.—There are at present five light vessels, six island, pile, or rock lighthouses, and forty short lighthouses around the coasts of the United Kingdom, which have been placed in electrical communication with the general telegraph system of the country at the national charge.

The Danish System.—In August last the Royal Commission visited Denmark and inspected the system of electrical communication with lighthouses and life-saving stations in that country. The system of electrical communication with lighthouses in Denmark is described at some length. Briefly, the system is practically an extension of the general telegraph system of the country. The use which is made of the wires for private and business purposes far exceeds the use to which the connections are put for the purpose of affording assistance to vessels in distress. Much of the important work which is done in the United Kingdom by the Coastguard, the Postoffice, and various other agencies is carried on in Denmark by the lighthouse authorities. At Hanstholm, Hirshals, Skagen and Hammeren lighthouses in Denmark, to which signal stations are attached, messages of any nature, made by means of the International Code of Signals, are received from passing ships, and are forwarded by wire to their destinations, and telegrams can also be sent to the lighthouses to be signaled to passing vessels.

The Royal Commission was unable to ascertain what has been the cost to the State of establishing electrical communication with lighthouses in Denmark, or what the annual expenses and receipts are, but the latter, they understand, are not sufficient to counterbalance the expenses.

Working of Cables Already Connected.—Kentish Knock light vessel.—(1) On May 18, 1895, the veering (electric) cable was found to be broken. (2) On July 12, 1895, communication was interrupted, the veering (electric) cable having been broken by the lightship riding to it. (3) On December 7, 1895, the veering (electric) cable parted, the sheathing having become damaged some time previously.

Goodwin (North Sand Head) light vessel.—(1) On January 30, 1895, the veering (electric) cable was reported to be broken. (2) The cable laid on April 10, lasted until October 24, 1895, when it broke.

Hasborough light vessel.—(1) On May 18, 1895, the first cable to the lightship parted. (2) On November 19, 1895, the veering (electric) cable broke. (3) Communication was again interrupted on December 8.

Shipwash light vessel.—The first cable to the lightship broke on August 20, 1895. No further interruption in communication occurred during the year, but as the result of a heavy gale, the outer sheathing of the veering (electric) cable was damaged, and some repairs were effected on December 2.

Formby light vessel.—Electrical communication with this lightship in Liverpool Bay was established on October 20, 1895. This vessel has been supplied with a new form of veering (electric) cable of a more flexible nature, and protected with rings of lignum vitæ, in order to save it from being chafed by the mooring chains, and by the light vessel herself. No interruption in communication had occurred up to December 31, 1895.

Gunfleet pile lighthouse.—No interruption in electrical communication had occurred since the cable was laid in October, 1893.

Tuskar lighthouse.—Telephonic communication with this lighthouse had not been interrupted since it was established on September 10, 1894, although the cable was slightly injured in October last.

Fastnet lighthouse.—In our first report we recommended the establishment of electrical communication with this lighthouse, which is situated about seven miles off the southwest corner of Ireland. The precipitous rock on which the lighthouse is built is exposed to the full force of the Atlantic seas, and is unapproachable except in calm weather. In 1885 electrical communication by a continuous cable was established with the lighthouse at the instance of the Committee of Lloyds, but it was abandoned at the end of eighteen months, after several lengthy interruptions in communication had occurred. Having regard to the difficulty of maintaining electrical communication with the Fastnet by means of a continuous cable, it was recommended that a non-continuous system should be tried, and effect was given to the recommendation on July 18, 1895.

Caldy Island lighthouse.—This lighthouse, in Carmarthen Bay, was electrically connected on July 29, 1895, and no interruption in communication occurred during the year.

Maplin pile lighthouse.—Electrical communication was effected with this lighthouse, off the north entrance to the Thames, on September 5, 1895, and no interruption had occurred up to the close of the year.

Conclusions.—It is seen that, as far as lighthouses are concerned the cables which have been laid have worked satisfactorily. The first outlying lighthouse which was connected with the mainland was the Gunfleet pile lighthouse, which was placed in electrical communication with Walton-on-the-Naze on October 2, 1893. Since that date four more outlying lighthouses (excluding that on Lundy Island) have been connected, and, although some of these stations are in very exposed positions, communication has not been interrupted with any one of them except the Fastnet.

As regards the cables to the light vessels the returns are not so satisfactory as was anticipated, but there is reason to believe that many, if not all, of the interruptions have been due to remediable causes, and endeavors are being directed to remove those causes and also to experimenting upon a system of communication by induction as suggested in the last report. Under this system the cable running from the shore is laid in a circle on the bottom of the sea immediately under the light vessel, the circle having such an area that the vessel will always be within the circumference of it. Round the deck of the light vessel a number of turns of insulated wire are coiled, which are in connection with a telephonic receiver on board the ship. An intermittent vibratory current is sent through the cable, and is made and interrupted by a Morse key. The vibrations act by induction on the coils of wire on the light vessel and produce buzzing sounds in the telephone, which, being intermitted by the Morse key, are read as in the ordinary Morse code. By means of a special arrangement a call bell can be rung. In the same way messages can be sent from the light vessel to the shore. This system has not yet been subjected to a practical test at a lightship; but the commission regard it as offering greater chances of success than any of the other inventions of the same nature which they have had before them, and meanwhile defer recommending the establishment of electrical communication with any further light stations, awaiting the result of the experiments which are about to be made.

NITRIC ACID PRODUCED FROM AIR.

It is reported that Messrs. Siemens & Halske, of Berlin, have patented in Germany a process for producing nitric acid from air. It is found that if air is mixed with ammonium gas and subjected to a discharge, obtained under certain definite conditions from an induction coil, ammonium nitrate is formed in large quantities, from which nitric acid is readily obtained. A mixture which has shown good results contains 100 parts by volume of air with one or two parts of ammonium gas. An excess of ammonium gas does not interfere with the reaction and can be recovered.

THE BABCOCK ELECTRIC SOUNDER.

An electric sounder has been invented by Dr. J. F. Babcock, of Bangor, Me., for use as a substitute for the hand lead upon vessels approaching a coast or shoal in darkness or fog when the position of the vessel is doubtful. Briefly stated, the apparatus consists of a metallic cylinder having a water-tight chamber, partially within which chamber a piston works longitudinally. Upon the outer end of the piston is a heavy ball, the weight of which, when the apparatus is swinging clear in the water, keeps open an electric circuit which, when the apparatus rests (in any position) upon the bottom, is closed by the action of a powerful spring.

When the sounder takes the bottom and the circuit is closed, the current, conveyed by wires running in the cable by which the sounder is attached to the ship, rings a bell in any desired part of the ship, giving immediate notice.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 23, 1896.

Alarms and Signals:—

AUTOMATIC RAILWAY SIGNAL. H. V. Miller, Bloomington, Ill., 562,639. Filed May 1, 1896.
In combination with the rail and ties a cross-bar, two blocks, a lever and its frame provided with standard and contact springs.

ALARM. R. W. J. Kraus, New York, 562,731. Filed Jan. 30, 1896.
A cage, a barokinetic circuit closer, and a guide for directing the falling of an unconscious body within the cage upon the circuit-closer.

Secondary Batteries:—

SECONDARY BATTERY. R. J. Gulcher, Charlottenburg, Germany, 562,396. Filed Feb. 29, 1896.
A fabric made of lead threads as warp and glass or quartz threads as woof, and a frame of lead.

PROCESS OF UTILIZING MATERIAL OF WORN-OUT SECONDARY BATTERIES. W. L. Silvey, Dayton, O., 562,776. Filed Nov. 19, 1895.
Consists in first washing the plates in water to eliminate the sulfuric acid, then subjecting them to the action of heat, then melting the plates and converting them into finely divided lead and oxids of lead, then adding a quantity of low oxid of lead, then forming the material into a paste and applying the paste to a grid, and finally hardening the plates.

Conductors, Conduits, and Insulators:—

WIRE HOLDER. L. M. Hakansson, Mason City, Ia., 562,528. Filed April 23, 1896.
Provided with arms on its upper end, under which a wire is forced into a locked position by turning the head of the holder.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. L. K. Oppenheimer, Cincinnati, O., 562,647. Filed Dec. 21, 1895.

Dynamos and Motors:—

ALTERNATING CURRENT MOTOR. E. Arnold, Zurich, Switzerland, 562,365. Filed Jan. 11, 1893.
The field coils and some of the armature coils are connected with the source of alternating currents, and establish induced currents in locally-closed armature coils, whereby two distinct moments may be produced varying with, and regulated by, the speed of the motor.

ELECTRIC MOTOR AND DYNAMO. E. Arnold, Carlsruhe, Germany, 562,366. Filed April 5, 1895.
An armature commutator and brush therefor, with resistances introduced in alternate commutator connections.

ALTERNATING CURRENT MOTOR. M. J. Wightman, Lynn, Mass., 562,686. Filed July 26, 1888.
An effective rotation is produced by parallel circuits formed upon a ring core, one of which is closed on itself and armature and an interposed copper conductor.

Electro-Metallurgy:—

ELECTRIC FURNACE. W. R. King and F. Wyatt, New York, 562,400. Filed Jan. 24, 1896.
Provided with a centrally located hollow movable electrode, whereby the length of the electric arc is regulated, an inner tube extending downward inside said hollow electrode and serving as a central feed, and mechanism, whereby the material to be smelted is fed into said furnace through said inner tube and deposited within the field of said electric arc.

PROCESS FOR FORMING CALCIUM CARBIDE. W. R. King and F. Wyatt, New York, 562,402. Filed April 14, 1896.
Consists in the heating of the vertical center of a mound composed of pulverized coke and ground lime to a white heat by the passage of an electric current along a conductor core.

ELECTRIC FURNACE. W. R. King and F. Wyatt, New York, 562,403. Filed April 21, 1896.
Employs the incandescent principle in distinction from the arc principle.

ELECTRIC FURNACE. W. R. King, New York, 562,404. Filed Feb. 1, 1896.
Employs more than one arc.

PROCESS OF REDUCING ALUMINUM. H. F. D. Schwahn, Kansas City, Mo., 562,785. Filed Jan. 31, 1895.
Details of process.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. D. Higham, Boston, Mass., 562,609. Filed March 31, 1896.
Embodies a close fitting hood stationary with the lamp frame, and inclosing the arc.

Measurement:—

ELECTRIC METER. A. G. Waterhouse, Hartford, Conn., 562,680. Filed March 25, 1895.
The combination of an ammeter having a movable part actuated by the electric current to be measured and a compensator and registering device worked by one or more derived circuit currents.

Miscellaneous:—

CIGAR LIGHTER. A. C. Gruhlke, Waterloo, and W. F. Kessler, Auburn, Ind., 562,395. Filed Dec. 6, 1895.
A device automatically lighted by an electric spark when the lighter is pulled toward a person, and extinguished when released.

ELECTRICAL ADVERTISING APPARATUS. C. E. Skinner, Pittsburg, Pa., 562,429. Filed Feb. 28, 1894.
Two sets of insulated conducting bodies disposed to display advertising letters or designs, in combination with a source of alternating currents.

ELECTRICAL RELEASING DEVICE. C. A. Stearns, Watertown, Mass., 562,431. Filed April 15, 1896.
An electromagnet and an armature therefor normally locked with apparatus to be released thereby; and a cushion or spring interposed between the armature and its resisting-contact.

AUTOMATIC OPERATION OF ELECTRIC GENERATORS. F. E. Kinsman, Plainfield, N. J., 562,541. Filed June 23, 1893.
The combination of a locomotive boiler, a dynamo and engine for operating the same and an interposed valve set to open connection there between at ordinary blow-off pressure.

ESCAPEMENT MECHANISM. C. E. Allen, Washington, D. C., 562,561. Filed May 28, 1894.
An escapement wheel provided with movable arms mounted thereon, and controlled by means of the electric current.

BANK OF ELECTROMAGNETS. C. E. Allen, Salem, Mass., 562,564. Filed Oct. 28, 1895.
Consists of a number of iron-clad magnets, arranged in such manner that the magnetic pull of two or more magnets is converted into one mechanical thrust.

MEDICAL ELECTRODE. W. P. Horton, Jr., Cleveland, O., 562,765. Filed Dec. 30, 1895.
A plate having a flange on the front face, thereby forming a cavity for the reception of absorbent material, forwardly bent loops at its ends, and a binding post on its rear side.

ELECTRIC LIGHTER. H. E. Rider, Brooklyn, N. Y., 562,775. Filed May 2, 1895.
Comprises a torch and means for electrically lighting said torch through the movement of taking it from its support.

APPARATUS FOR GENERATING ACETYLENE GAS. William R. King and Francis Wyatt, New York, N. Y., 562,401. Filed Jan. 29, 1896.
Consists of a generator revolubly mounted on a shaft and provided with means whereby the solid material and the liquid material may be introduced at opposite ends of the generator and may be brought together at the middle thereof.

Railways and Appliances:—

ELECTRIC RAILWAY. H. Brandenburg, Chicago, Ill., 562,453. Filed March 11, 1895.
Employs an I-shaped rail having the integral laterally recessed flange on one side of the head of the trolley conductor seated in and closing said longitudinal recess.

TRAVELING CONTACT OR PLOW FOR UNDERGROUND ELECTRIC RAILWAYS. S. L. Phillips, Washington, D. C., 562,483. Filed Jan. 21, 1896.
An insulating cover comprising two sections, clamps for securing said sections to the plow, and fastenings for detachably engaging the ends of the sections.

TRAVELING CONTACT FOR UNDERGROUND ELECTRIC RAILWAYS. S. L. Phillips, Washington, D. C., 562,484. Filed Jan. 21, 1896.
Similar to above.

TROLLEY. H. A. Seymour, Washington, D. C., 562,494. Filed Feb. 20, 1896.
Employs an electromagnet for forcing the trolley into contact with the conductor.

ELECTRIC CONTROLLER. E. A. Sperry, Cleveland, O., 562,501. Filed Feb. 20, 1895.
A main moving element of the controller for each circuit, in combination with means for dissimultaneous operation of the moving elements.

ELECTRIC LOCOMOTIVE. I. E. Storey, Boulder, Colo., 562,502. Filed June 29, 1892.
Method of mounting motor.

TROLLEY DEVICE. H. A. Gray, New Haven, Conn., 562,523. Filed Aug. 1, 1895.
Oppositely located, antifriction devices, supported upon the head above the wheel and capable of both an axial and a rising and falling movement, and means for causing said devices to approach each other in their upward movement.

APPARATUS FOR OPERATING TROLLEY ARMS. P. J. Dowling, Waterbury, Conn., 562,591. Filed July 23, 1895.
Provides a releasing mechanism in connection with the trolley pole whereby the pole will be prevented from striking the guy wires when thrown out of its operative position with the line wire.

ELECTRIC LOCOMOTIVE. John C. Henry, Westfield, N. J., 562,398. Filed April 22, 1895.
A motor having an armature shaft centrally located therein and extending laterally through bearings in the truck frame and a track wheel on each end of shaft.

ELECTRIC LOCOMOTIVE TRUCK. William P. Henszey, Philadelphia, Pa., 562,607. Filed Oct. 4, 1895.
The combination in a car truck, of the side frames, the top plate extending from one side frame to the other, openings in the top plate, with a bolster having a center plate and side bearing blocks extending through openings in the top plate.

ELECTRIC RAILWAY. Rudolph M. Hunter, Philadelphia, Pa., 562,766. Filed Sept. 23, 1896.
A switch, electrically operated from the car.

Regulation:

RHEOSTAT FOR ELECTRIC HEATER. W. S. Hadaway, Jr., New York, and W. E. Davis, Malden, Mass., 562,527. Filed July 18, 1895.
The resistance conductor is combined with a suitable non-conducting core in such a manner that if the conductor is broken the broken ends will be supported by the non-conducting core and short circuiting prevented.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS. R. C. Smith, Yonkers, N. Y., 562,745. Filed Jan. 25, 1892.
A reversing switch, an auxiliary switch, a safety resistance in the armature circuit, and a resistance in the field magnet circuit.

Switches, Cut-Outs etc.:—

OUTLET BOX AND FIXTURE SUPPORT. C. O. Mailloux, New York, 562,633. Filed Feb. 20, 1895.
A seat formed in the bottom of box, a removable bushing fitted to said seat, and a bolt passing through said bushing for securing the box in place.

ELECTRIC SWITCHBOARD AND CIRCUIT MAKER. A. L. Pratt, Kalamazoo, Mich., 562,658. Filed April 9, 1896.
Provides means to lock the switch at each shift from one set of terminals to another.

Telephones:—

SYSTEM OF CURRENT SUPPLY FOR TELEPHONE CIRCUITS. J. S. Stone, Boston, Mass., 562,435. Filed April 23, 1896.
The central source of current may be used for signaling purposes.

THE NASSAU COMPANY, OF BROOKLYN, AND THE UNDERRUNNING TROLLEY PATENT—SUIT DISCONTINUED.—The suit of the Thomson-Houston Electric Company against the Nassau Electric Company, of Brooklyn, for alleged infringement of a certain trolley appliance was last week stricken from the calendar in the United States Circuit Court, by order of Judge Lacombe. The Nassau Company agreed to pay $20,000 for the appliances now in use and $100 for each additional one used. In a similar suit against the Union Railway Company the motion set down for argument was also temporarily removed from the calendar.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

GUNNING FOR ORDERS.

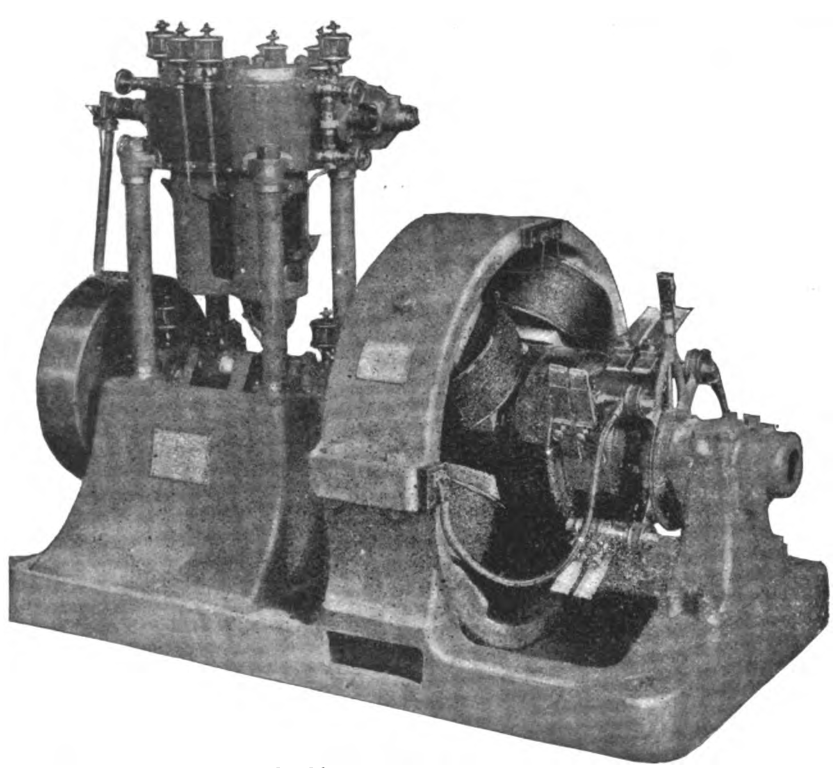
THE usual peace and quiet of our sanctum were rudely disturbed last week by the arrival of a suspicious-looking box, which upon opening was found to contain a full-size Winchester repeating rifle. As we are at peace with all the world the murderous weapon is of no use to us; but a legend on the butt of the gun serves to remind us that the American Electrical Works, of Providence, R. I., are asking all their friends to join in the celebration of the glorious Fourth of July.

"Our Goods Hit the Mark," which is proclaimed by a card on the magazine of the rifle, is an axiom in connection with 'Gene Phillips' wares, and his neat method of making the fact known is in consonance with his well-known modesty.

THE G. E. MARINE COMBINATION PLANT.

One of the most important requirements in an electric plant for shipboard lighting and power is the smallness of space in which both engine and dynamos can be set up consistent with efficiency of operation and satisfactory service. In marine electric practice, the General Electric Company has had a wide and most varied experience, and having installed a large number of marine plants on all classes of vessels both merchant and governmental, has full knowledge of the necessary requirements. It has brought down the marine dynamos to their smallest practical size and in order that they may be operated most efficiently, has also developed a line of steam engines to which the dynamos may be coupled directly. The capacities of the engine range from two kilowatts to fifty kilowatts.

They are of simple design and noteworthy on account of the few parts which enter into their construction, while every part is easily accessible. The sets occupy a minimum of floor space, the engine bed being carried out to support the dynamo. While this construction gives a massive appearance, the bed is so carefully cored out that the capacity is approximately only 3½ watts per lb. The generators are of the four-pole type with ironclad armatures, a special armature winding being adopted to reduce the height and length of the sets to a minimum.



THE G. E. MARINE GENERATOR COMBINATION.

PREMIER BATTERIES AND MOTORS.

MR. M. R. RODRIGUES, manufacturing electrician, of 17-19 Whipple street, Brooklyn, N. Y., has issued a pamphlet describing his well-known "Premier" products. These include the Premier motors, batteries and induction coils, besides which Mr. Rodrigues manufactures medical batteries, phonographs and electrical novelties and supplies of all kinds. The Premier motors are made up in several sizes, the smallest being but three inches high. This size is made for driving small mechanical toys, etc., and is run with one battery cell. The largest size is used as a fan motor and is run with two or three cells. It carries a ten-inch fan, runs at about 1,000 revolutions per minute and is well and substantially made of the best materials.

The Globe ironclad fan motor is manufactured by Mr. Rodrigues for use on 110-volt circuits. This is adjustable for two speeds and is provided with a wire guard.

A. K. WARREN & CO.

Mr. A. K. Warren, of A. K. Warren & Co., 465 Greenwich street, has recently taken into partnership with him Mr. J. R. Steers, of this city. Mr. Warren started in the electrical repair business under the title of the "New York Electrical Repair Company" on a small scale about three years ago, and has been obliged, in order to take care of the work and insure prompt deliveries, to constantly increase his plant and facilities, until his shop has become one of the recognized repair shops for all classes of electrical work in the Eastern district.

A few months ago Mr. Warren began the business of electrical maintenance, as, from his repair business and shop facilities, he was in a position eminently fitted to take up that line and furnish quick work and low estimates. In addition to this, some of the largest electrical manufacturing companies, having found it more economical to turn over to him the erection of all their large generators and machines in this vicinity than to send their own men from the factory, the business has grown beyond all proportions of what was anticipated. It was found that still more room, plant, and increased capital were required to handle the work. Mr. Warren also found that he could not attend to the outside work, making out of estimates, and all the business details and still give the time and attention he desired to the work in the shop.

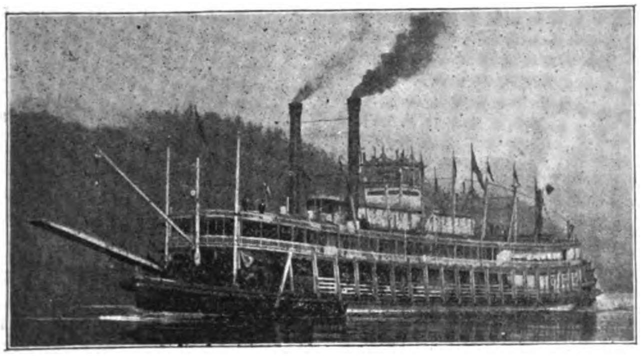
Mr. Steers has put into the firm all the capital that is required for the necessary increase of plant, and for working capital. Two more floors, fully equipped with all the necessary machinery and appliances, have been added to their factory; and he will have charge of all the office work and the finances of the company. The old title of A. K. Warren & Co. will be continued.

ELECTRICITY ON AN OHIO RIVER BOAT.

The most recent addition to the fleet of steamboats plying on the Ohio is the "Virginia," of the Pittsburg and Cincinnati line, launched last November, from the ways of the Cincinnati Marine Railway Company. She is of the flat-bottomed, stern wheel type, 235 feet long, 40 feet beam and 7 feet depth of hold in the clear. The cabin is full length and is 190 feet long, with fifty staterooms opening upon it.

The machinery consists of a double set of tandem compound condensing engines with high pressure cylinders of 15 inches diameter, low pressure of 33¼ inches diameter and 84 inches stroke. Steam at 186 lbs. is supplied by one battery of four externally fired steel boilers, 42 inches in diameter and 20 feet long. The "Virginia" is lighted by electricity throughout, the General Electric Company furnishing the entire equipment.

The generator is a 25 kilowatt multipolar machine directly



ELECTRICALLY LIGHTED OHIO RIVER STEAMBOAT.

connected to a 40 horse-power automatic engine. The plant is set up on the lower deck, in the main engine rooms, and furnishes current for 250 incandescent lamps, two arc lamps and one searchlight. One hundred incandescent lamps are used in the main cabin, one in each stateroom, and 100 more in the texas and elsewhere. The searchlight is one of the regular General Electric 12-inch projectors, fixed to the crane mast forward and controlled from the pilot house.

The switchboard is of the skeleton type and carries a voltmeter and ammeter, rheostat and switches controlling seven circuits. Each switch and junction box located at different points in the vessel is of the G. E. marine watertight type and everything has been done to make the installation perfect.

The "Virginia" now plies regularly between Cincinnati and Pittsburg, and is the handsomest and most perfectly equipped boat ever seen on the Ohio River.

MICANITE SPECIALTIES.

We are in receipt of a sample of the latest production in micanite made by the Mica Insulator Company, 218 Water street, N. Y., and 153 Lake street, Chicago. The sample consists of a plate of extra flexible micanite and is built up of pure India sheet mica. It is especially adapted to be used as an insulation for armature slots, armature cores, field magnet coils, etc., as, on account of its extreme flexibility, it can be bent into almost any desired shape. It is furnished in sheets up to 36 x 36 inches in size, and of any desired thickness from 10-1,000 of an inch upward.

Besides the plates, micanite is manufactured in a great number of forms. These include segments, rings, cylinders, tubes, rheostat linings and others too numerous to mention. The company reports the demand for micanite specialties on the increase both here and in Europe, and their Schenectady and London factories are both kept very busy filling orders.

ELECTRIC RAILWAY PROSELYTING LITERATURE.

The Brooklyn Heights Railroad Co. has begun the publication of a 24-page paper to be issued monthly, called "The Trolley." This is said to be the first publication of its kind ever put out by a street railway company and the company expect it to prove of value in advertising their special car service as well as the pleasure resorts reached by their lines, and to increase general traffic. Twenty-five thousand of these will be distributed each month throughout the Greater New York.

THE AMERICAN ORDNANCE COMPANY, of Bridgeport, Conn., are about to install electric lights in their extensive shops and are in the market for supplies for 1,500 incandescent and 30 arc lamps. Catalogues, price lists, etc., should be sent to Mr. E. O. Crocker, the company's electrical engineer.

WESTERN NOTES.

THE VALENTINE CLARK COMPANY, dealers in poles for overhead wiring purposes, have changed their headquarters in Chicago from 704 The Rookery to 804 and 805 Gaff Building, La Salle street.

THE BALL ENGINE COMPANY, of Erie, Pa., have removed their Chicago office from 506 The Rookery to 1526 Monadnock Block. The office will be in charge of their sales agent, Mr. W. A. Kreider.

CALIFORNIA NOTES.

The Electric Specialties Company, of Oakland, Cal., have just installed a 90-light system in the pumping station of the Oakland Water Company, at Alvarado. The plant consists of a 5.62 k. w. 125-volt Westinghouse generator, driven by a ten-horse-power Racine engine. The works are wired for 1½ per cent. loss and no expense has been spared to make the plant the most complete of its size in the country.

The same company are now installing a 500-light plant at the suburban residence of Mr. William J. Dingee, three miles from Oakland. The current for this system is taken from the Piedmont and Mountain View Railway, one and one-third miles distant, and at the residence reduced to 110 volts by a "Robbins direct-current converter," which admits of 40 per cent. variation in current. The system has been in operation for several weeks in part and has proved very satisfactory. This is the first application of this converter on so large a scale, and it is being watched with considerable interest by local railroad men.

The Piedmont and Mountain View Railway have just ordered another 150-kilowatt generator of the General Electric Company. The new machine is expected to be running within thirty days.

Ground has been broken for the new electric road between Monterey, Cal., and Pacific Grove, and the work is being pushed rapidly forward. We are not advised as to the names of contractors for the electric equipment.

NEW YORK NOTES.

THE ELECTRO-CYANIDE GOLD AND SILVER EXTRACTING COMPANY, of New York, has been formed by Henry Wetjen, of Brooklyn; John Meyer, of New York City, and others, with a capital stock of $25,000.

THE C & C ELECTRIC CO., of New York, have secured the services of Mr. J. Holt Gates, who will push the sale of C & C appartus in Chicago hereafter. Mr. Gates requires no introduction to the electrical trade, being one of the best known electrical men in the West.

MESSRS. STANLEY & PATTERSON, of 32 and 34 Frankfort street, have made arrangements to act as sole selling agents in the United States, for Fleming's woven wire dynamo brushes. With increased facilities for manufacturing, there will be no delay in the future in filling orders for any size of brush, or any quantities that may be required.

The Pioneer lamp has won the confidence of several parties having a capital of over $2,000,000, who are now backing up the Electric Arc Light Company in the fullest manner. A firm and aggressive policy has been adopted by the company, manufacturing on a large scale, advertising freely, and establishing agencies throughout the country. Elegant offices have been fitted up at 687 and 689 Broadway, and a fine laboratory at 250 and 252 Mercer street, New York City.

THE GLEN FALLS PAPER COMPANY, of Glen Falls, N. Y., are making extensive alterations and additions to their plant, and on all their new buildings they are placing roofs supported by steel trusses. This form of construction is especially adapted for buildings devoted to the manufacture of paper, and wherever new buildings are put up, or old ones remodelled, steel is almost invariably used. The trusses for the work which they are now doing, will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE MATTHEWS-NORTHRUP COMPANY, Buffalo, N. Y., have just issued the eighth edition of their "Postal Dictionary," an alphabetical handbook of postal rates, laws, and regulations. It has been compiled from official sources with the utmost care, and will be found thoroughly accurate, complete, and up-to-date in all particulars. Business men and others who use the mails can refer to the Postal Dictionary with profit and pleasure in the numerous cases of doubt that arise in the course of correspondence and of merchandise mail. The book fits a desk pigeon-hole snugly, and is substantially and neatly bound in tough manilla paper. The price of single copies is 15 cents, which includes postage.

WESTERN NOTES.

THE C. E. WOODRUFF COMPANY, 235 Lake street, gave a bill of sale of all their effects to the Joliet National Bank, Joliet, Ill. Mr. Mason, the manager of the Bank, is in possession of everything on the premises.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, report the following contracts, which they have secured recently: 1,000 drop switchboards at Sea Crosse, Wis.; 100 telephones, Sandersville, Ga.; 200 telephones and 200 drop switchboard, Winchester, Ky.

GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., with the approach of summer are beginning to receive orders for their new type lightning arresters, which were described in our pages last week. Among the recent orders is one for the entire equipment of the Hamilton (Ont.), Radial Railway, with their improved pole type.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, O., inform us that Mr. Cyrus Robinson, of their mining department, has resigned his position with their company, to take effect July 1. All correspondence pertaining to their mining appliances, will be taken care of from the Columbus office as heretofore.

THE METROPOLITAN ELECTRIC COMPANY have taken the Northwestern agency of the Missouri Telephone Manufacturing Company, St. Louis, Mo., and are carrying a full line of their celebrated telephones, switchboard apparatus and patent gravity hooks. All telephones are guaranteed. Correspondence will be answered promptly.

THE ELECTRIC APPLIANCE COMPANY are carrying in Chicago a well assorted stock of Electra carbons, and are prepared to fill orders at manufacturers' prices. They claim that the Electra carbon is the cleanest imported carbon on the market, burning with the least possible amount of dust, hence giving a longer life than would otherwise be possible.

THE CYCLE ELECTRIC LIGHT COMPANY, at 20 West Randolph street, Chicago, has confessed judgment for $11,-036.42 in the Superior Court. The judgment was made in favor of Thomas A. Snider, president of the company, and was rendered on a demand note made May 6 last. The company has been engaged in the manufacture of electric bicycle lamps. The officers of the concern are Thomas A. Snider, president, and W. A. Crowdus, secretary.

THE ELECTRICAL APPLIANCE COMPANY have taken the general Western agency for the already far-famed Armorite iron-armored interior conduit, which is creating a very great deal of favorable comment, on account of its many unique and desirable features. One of the great points claimed is that the conduit can be bent cold into almost any shape, thus saving the expense of elbows and greatly reducing the time required to install the conduit. The Electric Appliance Company consider Armorite a "winner."

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, has recently purchased a new factory, located at Desplaines, Ill., a few miles west of Chicago. The factory is a substantially built brick structure, and will give the Sunbeam company about double the floor space of its present factory. It will be fitted up with all of the very latest devices used in the manufacture of lamps, which will give the Sunbeam company facilities that are second to none, and a largely increased capacity.

ALTHOUGH the demand for china insulating material and batteries has fallen off for the present, the Peru Electric Manufacturing Company, of Peru, Indiana, are running their factory full time, making up stock. This firm have been established in business since 1892 and are now employing about 100 men steadily, both on china insulating material and batteries. Their goods, throughout, are exceptionally well made, which accounts for their growing demand, both in this and in foreign countries. We are informed that large shipments were recently made by the Peru Electric Manufacturing Company to Nova Scotia and the City of Mexico. They anticipate a brisk trade for the fall.

THE CUTLER HAMMER MANUFACTURING COMPANY have removed their plant from 128 South Clinton street, Chicago, to more commodious quarters in the Dunn Building, at 71 West Jackson street. The business of this company has recently increased so rapidly that it was found to be absolutely necessary to secure more space for manufacturing, as their old quarters were utterly inadequate for the purpose of carrying on their trade. To aid them still further they have purchased the plant of the Gates Electric Manufacturing Company, and when they get their new factory in full working order they will be enabled to turn out a large quantity of rheostats, which they intend to manufacture exclusively. They have also secured the services of quite a number of extra hands who are experienced in the business, thus making their factory thoroughly complete in every respect.

NEW YORK NOTES.

THE CLONBROCK STEAM BOILER WORKS, of Brooklyn, are having so large an accession of orders recently that the shops are running on full time, with a large number of orders ahead. The outlook is particularly bright for work of other kinds.

MESSRS. H. E. & C. BAXTER, Bedford, Division and Canton streets, Brooklyn, N. Y., report a satisfactory business, especially on their No. 7707 electric bell. Their full force is still kept busy on these, as well as on annunciators, push buttons, switches, burglar alarms, springs and other specialties.

TEN HOURS' a day steady work is the schedule time at the New York office of the Joseph Dixon Crucible Company, 68 Reade street. Mr. John H. Baird, the genial manager, with efficient help, is very busy filling orders for resistance rods, ranging from 1-5 to 25,000 ohms, graphite pencils and many other articles made of graphite.

THE LECLANCHE BATTERY COMPANY, East 131st street, New York, are now putting on the market and pushing the sale of their zinc holder. It is an ingenious device for holding the zinc in the spout of any battery jar, and preventing it leaning against the porous cup with a possibility of short-circuiting. The device is the invention of Mr. Brewer, president of the Leclanché Battery Company. The company will take pleasure in mailing samples to any one free upon application.

THE PALERMO MICA CO., 27 Peck Slip, New York City, who are dealers in mica exclusively, are sending out to the trade a new price list of all grades of mica for electrical purposes. Besides their sheet mica, this firm supplies segments and rings for commutators of all makes, cut to pattern and built up to any desired thickness. The company can furnish mica in any quantity and of any quality desired.

THERE is a race for first place in public favor between the old short-hour and the new long-hour arc lamp. The Pioneer guarantees a run of 100 to 150 hours, while the old lamps give between 8 and 10 hours. This is prettily illustrated by the cartoon of the Electric Arc Light Company. In all the large orders recently placed, the long-hour lamp has received serious and favorable consideration. In addition to the money saved by using only one pair of carbons a month instead of one a day, the annoyances of daily trimming and the scattering of carbon dust are avoided.

MR. GEORGE FINK SPENCER, is at present on a combined pleasure and business tour through Europe and is expected to return about the middle of July. Mr. Spencer is the manager for I. P. Frink, reflector manufacturer, 551 Pearl street, New York, whose goods have been installed in such places as the Metropolitan Art Gallery, Central Park, Carnegie Library and Art Gallery, Pittsburg, and many other well-known galleries, churches, etc. Frink's improved reflectors are highly recommended for use in connection with electric, gas and oil light.

MR. D. S. PLUMB, 24 Boudinot street, Newark, N. J., whose advertisement appears on another page, established himself in 1881, originally as a manufacturer of very fine clocks. The thorough knowledge of how to make these delicate and intricate mechanical devices and the like, gradually led him into the business of making specialties of this nature for manufacturers of heavy machinery, who have not the facilities nor employés to turn out delicately adjusted clock mechanism. Mr. Plumb's steadily growing business is the result of the demand he created, the electrical line largely coming in for its share. Among the many specialties manufactured are electric meters, clockwork arrangements, automatic devices, intricate mechanical instruments, etc., also special screw machine work. Mr. Plumb caters more to manufacturing special devices for other manufacturers, and solicits correspondence on the subject.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have secured a contract for a steel rolling mill building, 103 feet wide and 112 feet long, from the Pennsylvania Bolt and Nut Company, of Lebanon, Penn. The building will have a steel frame, and roof and the sides will be of corrugated iron.

MR. JOHN BECKER, of Fitchburg, Mass., is making a number of sales, particularly among electrical people, of his milling machines. A little pamphlet, which he has just issued giving some of the users of this machinery, presents a number of names well known either as being directly interested in the electrical field, or connected with it in some way.

Department News Items will be found in advertising pages.

THE

Electrical Engineer.

Vol. XXII. JULY 8, 1896. No. 427

Electric Lighting.

ON THE CAUSE OF CONTINUOUS SPECTRA IN EXHAUSTED TUBES.

BY DR. W. H. BIRCHMORE.

Among my exhausted tubes is one, a bulb-tube, which presents remarkable phenomena when subjected to the action of an electric current. These phenomena are light relations and are of so interesting an order that I describe them in detail.

The Tube.—This is an ordinary exhausted bulb, containing two electrodes of aluminum; one a wire, the other a disc. These are separated by about 20 mm. and the disc has a diameter of 30 mm. The degree of exhaustion is not known. This is unfortunate, but unavoidable, as the tube was made by an electric lamp maker who "exhausted it perfectly," but left no small volume of gas within, as, indeed, is the usual condition in electric lamps.

The phenomena observed when the current from a coil is passed divide themselves variously according to the amount of the primary current, the arrangement of the condenser of the coil and the behavior of the current under the influence of the secondary condenser. The influence of this last mentioned apparatus depends very largely on the amount of surface, but also in its relation to the amount of surface in the primary condenser.

The coil used in these experiments was provided with a "striking apparatus" so arranged that the length of spark could be varied from ⅛ inch by 1-16ths to the full length obtainable. The length most suitable for experimentation depended on the tubes in use. A spark ⅝ inch long in dry air represented the electrical stress required for the phenomena in series A; while 1½ inches was the stress employed in series B; and ¾ and 2 inches the proportions in series C and D.

The battery used for excitation in experiments series A and C was 7 amperes under 1.5 volts. While for B and D it was 11.5 amperes under the same pressure. Amperage and voltage were measured by instruments from J. W. Queen & Co.

Experiments, Series A.—These consisted in studies into the spectra of the tube (bulb-tube) just mentioned. Under the electrical stress mentioned, 7. amperes and 1.5 volts these spectra were bright lines on a black ground, when no secondary condenser was used. In effect they were the spectra shown in the cut of spectra published in The Electrical Engineer of March 25, 1896, as of the first exhausted bulb.

There was no luminosity to the ground spectrum, not even a green cloud; the spectrum was, and is whenever the experiment is repeated, a spectrum of bright lines and of but few of them. It is of importance to remember in this connection that the current of the coil is always in one direction; there is no return current and that this phenomenon is a regular criterion by which gases of various kinds are investigated.

The slit of the spectroscope was placed in the middle distance between the two poles, and the width of the slit was less than 1-5 mm. Therefore it may be safely stated that all the light was produced within the inter-electrode space by the electrical stress, and none of it by the possible radiation from the electrodes within the bulb.

Experiments, Series B, were identical in all respects with those of Series A except that a Leyden jar was introduced as a condenser.[1]

The introduction of this jar quite changes the conditions of the experiment and produces a correspondingly great change in the results. In the first place, the discharge is not of the same kind. It no longer has a definite direction, but discharges in waves, which are of inverse direction each to its predecessor. In other words, between each make and break from the coil an immense number of short time waves pass. This is easily proved by passing the spark from an apparatus thus arranged between electrodes of different substances when the spectra formed are confused mixtures of those of the two metals, showing that the current passes back and forth between the two electrodes in alternate directions.

Under circumstances such as these a line spectrum is still produced, but behind it appears a continuous spectrum extending from about the wave length of line A to far beyond that of line G. In other words, there is produced without the intervention of any red-hot material a spectrum containing nearly all the wave lengths of the one familiar to everybody. But while the wave lengths are all present, the number of waves of the various lengths differ entirely from those of an incandescent body, say a piece of white hot lime.

Indeed, the spectrum intensities may almost be said to be reversed. The maximum of light, that is, sense-perceived undulation is in the blue and violet, while the green is less intense and the yellow and red more indistinct in the order given. It is well known that when a body is heated, the first sensible undulation is in the green, and it appears as a sheen without perceptible hue. This same phenomenon appears in the case of the exhausted tube under electrical stress, but its location is the space midway between F and G, say, in the violet near the blue. It is also well known that the heat rays begin the scale in the ordinary light, while in the exhausted tube the chemical (actinic) rays take this place. The carbon molecule will begin radiating heat long before it begins to radiate light, but the tube will begin actinic undulations before light waves are given off, and I have taken photographs with tubes whose only visible spectrum was "the four bright lines." That the real efficient radiation here was an F—G radiation extending out beyond the H limit was shown by photographs of colored objects, diagrams in color and the like.

As was mentioned, in these series a bulb-tube was used, in which were electrodes so placed that the current passed within the tube from one electrode to the other under a condition of stress whose measure was the length of the spark in dry air. For if the stress within the tube exceeded the resistance of the air space, the spark would pass here and the tube would not increase in its luminous phenomena to the same degree, if at all. This method of arrangement therefore constituted a gauge of the minimum stress required to produce a given phenomenon.

If for this bulb-tube is substituted an exhausted tube with no internal electrodes and experiments series C and D are performed, results much as follows are reached.

Construction of the Tube.—The most satisfactory results in these two series were reached by the use of a tube 1 inch (25 mm.) in diameter, and 15 inches (325 mm.) long. Around this tube at equal distances from the middle (150 mm.) were placed two bands of tinfoil (25 mm. wide) stuck fast to the glass with fish glue. Around the pieces of foil was coiled copper wire, almost as if to form a band, to which were connected by proper contacts the wires from the coil. The exhaustion of the tube was controlled by a Sprengel pump.

The battery used is that for experiments C and D, and the extremes of the electrical stress are those given. The conditions were those of choice and were usually successful; it being understood that in series C the direction of the stress was always from band A to band B on the tube, no secondary condenser being used, while in the series D the stress alternated in direction, being in waves whose direction was alternately from A to B, and from B to A. The conditions which interfered with uniformity in the experiments were dampness and dust. These, by interfering with the insulating action of the glass between the bands, caused the most surprising variations in the stress needed at the "striking apparatus" to produce a given result, and to obtain a reasonable uniformity it was needful to wipe the tube with a warm dry cloth, sometimes, and to dust it always.

In experiments, series C, the Leyden jar was not used; in series D the Leyden jar was in circuit.

[1] This series seems more suited for discussion in this preliminary mention than the more elaborate ones with the Becquerel apparatus, which may be discussed later.

The Phenomena Observed During the Passage of the Current.—It is desired to insist upon the distinction between these experiments and those of De la Rue, in that the electrodes were internal in the De la Rue tubes, but in these experiments there was absolutely no connection by current between the vacuum within the tube and the current outside. The phenomena were those of induction and were experimentally proved to be of a very different order from ordinary induction phenomena.

Series C.—In these experiments the current had a distinct polarity and there was a definite make and break. Under these circumstances there was a striation, an alternation of dark and light spaces, so to say, within the tube. At first sight, these appeared to be the well known "striæ" of Spottiswood and De la Rue, but by carefully managing break, resistance and current condenser, it was possible to prove the luminous bands to be true vortices.

The direction of motion of the rotation was against the direcsight, these appeared to be the well known "striæ" of Spottisdirections; they are in the center of the tube from A to B, the other close to the inner surface of the glass from B to A; or perhaps the simile would be better, to say that there seemed to be friction between the surface of the glass and a current within producing the vortical rings.

A very slight disarrangement of the conditions—rapidity of break was the most effectual—caused a luminosity, a sort of indefinite sheen coincident with the axis of the tube surrounded by a "black space" parting the central sheen, which showed no striæ, from the rolling rings. There is sometimes a curious variation of this order. The "sheen" is not only axial, but fills the middle of the tube like a double-spindle, the thickest part in the middle, and the vortical rings then surround it at both ends, becoming less distinct towards the middle, where they merge into the luminous cloud. The precise conditions of the current and stress needed to effect this I do not know, but I seem to be able to produce it at will by passing a copper ring, insulated with hard rubber, over the tube.

This ring is 1 cm. wide, of copper foil, and has a diameter twice that of the tube. This sheen is most intense and luminous when a very long wire of small relative resistance is used to connect the poles of the coil to the tube, say, 500 feet of No. 16 wire—ordinary electrical bell wire with an insulating winding in place of the ordinary 3 feet of electric light flexible cord. This is probably the agent in producing the sheen, acting as a Leyden jar, and yet in not by any means the same degree, the current rushing backward and forward violently between each break and make. For the exact relation standard works give many details of observations and the results of many speculations and much study.

When the Leyden jar was inserted as a secondary condenser, and the stronger current used, a condition of luminosity was obtained by which good print could be distinctly and easily read. A watch held 500 mm. from the eyes and 3 metres from the tube, could be read to seconds, and colors were distinguished, not by their true hue, but as presenting differences. Crimson and indigo could not be distinguished, but blue and green, or green and yellow, could be easily parted. The distinction between yellow and blue was very distinct; yellow was evidently the critical color. Aureolin (cadmium sulphide), which by daylight and all ordinary light is an intense yellow, by this light is white. Cobalt blue shows true, as does the manganese violet, while indigo shows almost black. No combination of colors which I could make showed as a true gray. The reflection spectrum was equally anomalous, the brightness of the violets and very light blues being surprising.

These experiments seem to prove two things—first, that if the undulations of electrical force are sufficiently rapid, and of sufficient amplitude, wave lengths in the ether are produced which answer in all respects to light, in fact, are light; second, that the excitation produced in a closed tube differs in some way from that produced in one with electrodes inside it. Examination into the rationale of this thing gradually led to the following experiments: Disconnect the condenser of a small coil—¼ inch spark seems to be quite sufficient—but leave the breaking apparatus alone. Connect the primary current to the battery in the usual way. Now connect the exhausted tube to the coil as follows: Coil, bobbin of 500 feet No. 16 wire insulated, exhausted tube as described, another bobbin, coil. This makes a circuit of very large capacity in proportion to the coil, and the fluctuations are most enormous, and rapid.

The battery needed to work the coil is small; two dry cells have been found to be ample. The exhaustion being determined by experiment and the pump stopped at the point of election, the luminous cloud appears in perfect development, and with a continuous spectrum.

These facts being established, the questions involved are as follows: 1. Does this tube give as much, more, or less light than an incandescent lamp requiring the same battery power? This question I cannot answer yet as I have had no time to make the needed analyses.

2. How does the actinic power of the lamps compare? To this question a definite answer can be given. The exhausted tube is many times more efficient than the other

3. How is the luminous sensation produced? The prima facie answer is by undulations of the ether; but why not of some definite wave length, as can be shown to be the case under known conditions of current and exhaustion, instead of such a multitude of waves evidently discordant?

It is very plain by certain observations made by Hertz that the induction currents rushing through dry air have a limited relation, but these currents on the surface of a tube of glass neither clean nor dry may have a quite definite one, and it is the influence of the currents without the tube which produce the disturbance of the ether within, and yet the relation be quite unlike the relation of Hertz's experiments.

Still further, we do not yet know that the other undulations to which we refer have origin in the direct action of the current. It is quite contrary to all experience. Currents of high tension going definitely in one direction produce in a vacuum definite discontinuous spectra of bright lines. Why should a rapidly oscillating current produce another sort of spectrum which is really continuous and of so different an order. The doctrine of the degradation of vibrations seems to apply somehow, but in the present state of the theory it certainly does not definitely apply. A modification is possible.

One thing may be set down as certain, the light produced is not emitted by gases. These in all cases would give non-continuous spectra. If we can imagine water to be in such a condition that the heat of formation could exactly equal that required to expand the formed water under the conditions stated, we might imagine the heat produced to make a very minute amount of water incandescent. This explanation has been suggested by two well-known experimenters, but it presents difficulties; an explanation that dust may play a part is possible.

But it is also possible that the real agent is a precipitated carbon. To free any space like this from carbon dioxide without special precaution is very hard, and from experiments I am inclined to think combinations of carbon and hydrogen, as well as of carbon and oxygen, are present in nearly all these tubes in various combinations, and therefore I am inclined to believe the continuous spectrum to be that of carbon under a very peculiar physical condition. I am the more inclined to think this, because my declaration that the spectrum of the light of certain exhausted tubes was continuous was immediately after followed by the declaration from various others of similar observations, which, while in a way coinciding with those I made, seem rather to have been of the order of fluorescent overlapping spectra than to have been faint continuous ones.

At any rate the continuous spectrum is there. I have offered a speculation as to its possible origin, namely, the heat produced by the union (precipitation) of gaseous atoms, perhaps carbon, which heat is instantly dissipated by their return to the gaseous condition. This is an interesting field for speculation and may be one of valuable scientific discovery.

ELECTRIC WAVES.

Some experiments made by Cole's method on the refractive index and reflective power of water and alcohol for electric waves have been described in the "Annalen der Physik und Chemie," from which it would appear that for waves of 300 cm. to 600 cm. length the refractive index for water was 8.95 and for alcohol 5.20, which is in agreement with the figures obtained by other observers. With waves of 5 cm. length the two Fresnel formulæ give the same value of the refractive index from the observed reflective power; for water it was 8.8 and for alcohol 3.2; for alcohol the refractive index for long waves is appreciably greater than for short ones. It also appears that waves 5 cm. long pass only with great difficulty through even very thin layers of water of 0.04 cm., although long electric waves readily pass through the water and both traverse with ease wood, paper, rubber and many other opaque materials. With these waves reflection is total from metals when the oscillations are at right angles to the plane of incidence and only partial when they are parallel to this plane. It will be seen that all these values are exceedingly high compared with those for the longest known light waves.

MR. WALTER D. STEELE has been appointed city electrician of Detroit to succeed Mr. Alex Dow, resigned. Mr. Steele will have charge of the engineering department and of the operating and construction forces. Mr. Will F. Conant has also been appointed secretary and general manager of the city plant for the ensuing year.

SOME CENTRAL STATION ECONOMIES.[1]

BY P. G. GOSSLER.

IT is well known that many central stations which have not been operating on a paying basis have been turned into profitable investments by prompt measures having been taken to modernize them, and to put them on a footing to meet competition either from companies already in the field or contemplating entering it. To do this, it has generally been necessary to reconstruct the entire electrical part of the plant from the generators to the lines and transformers, replacing the old generators and transformers by the more efficient apparatus now manufactured; rebuilding and re-designing the switchboard, and last, but certainly not least, the re-arrangement of the feeders and mains, to give economical distribution, to overcome the inductive effects, and to bring the feeder losses within the limits of good practice.

The following gives results obtained from the partial reconstruction of one plant. It does not give a full idea of what will be accomplished by complete reconstruction, inasmuch as that part so far carried out has been confined to transformer and line changes.

To proceed with a systematic reconstruction, the first things necessary are reliable records, at least of what the plant and lines to be reconstructed consist. For the plant herein referred to it was necessary to establish pole line and circuit maps as well as transformer maps. It may be said that such a system of records in detail and kept up to date is necessary for the economical operating of an electrical lighting station.

For the pole line records a card catalogue was arranged, each card having a number corresponding to a pole; in connection with this card catalogue there is a map on which each pole is located with its number; also, for further convenience in making out reports and locating poles, each pole itself was numbered.

Fig. 1 represents a form of pole card which was found to answer the purpose very well.

On the card representing a particular pole all of the wires are shown in their relative positions on the pole by numbers placed over the pins to which the wires are attached, the numbers indicating the circuits of which the wires form a part. By means of this card the positions of the wires forming the different circuits were clearly shown, also what changes in the relative positions of the wires were necessary to overcome existing inductive effects, the latter being a source of much annoyance. In fact, the pumping on the circuits due to mutual induction, prior to their rearrangement, when circuits supported on the same pole were running from dynamos on different engines, was so serious and caused so much fluctuation of the lights that it was necessary to rearrange the relative positions of the feeders of all the circuits to counteract these inductive effects. Very satisfactory results were obtained when the rearrangement of the wires had been carried out. Prior to this change, to overcome fluctuation, it was necessary to feed all circuits on the same pole line from one set of dynamos operated by one engine, which was very often not convenient and only possible with a large loss in operating expenses.

In connection with this pole catalogue, circuit maps were arranged, which consisted of diagrams for each circuit, showing the streets upon which the circuit ran, and the size and length of each section of wire or wires.

At the same time these records were being made out, transformer charts were prepared, which consisted of maps for different sections of the city covered by the different circuits. On these maps each transformer was located by a small square stamped on the map, and within this square was written the name of the customer being served from this transformer, the number of lamps installed, the revenue per year, the revenue per lamp per year, the estimated number of hours burned per lamp per day, and the probable number of lamps burning at any one time. There is also indicated on these charts the size and length of secondary wires from the transformer to the customer's cut-out. All this information was found necessary for the proper "bunching" of customers on the transformers and for the loading of the transformer.

Wherever possible, secondary systems were established, to which several transformers were connected in parallel, in which case the size of the secondary mains between the transformers was such that the drop in these mains was small compared to the drop in the transformers themselves; in this way the transformers were made to share, more or less, the load equally between them. When a secondary system of distribution was not economical, single transformers were located. In determining whether a customer was to be included in a bunch of customers, all of whom were to be fed from one transformer, or whether it was more economical to place a separate transformer, it was necessary to make an approximate estimate of the cost of locating the transformer for each case. When the interest on the cost of placing a separate transformer, plus the cost of maintenance of the transformer, was more than the interest on the cost of connecting a customer to a transformer feeding other customers, the connection in question was made to the transformer feeding the "bunch." However, even if the difference in annual cost was small in favor of a separate transformer, connection was made to the "bunch." In making these calculations a fixed drop in the secondary mains was allowed, and the load, i. e., the probable number of lamps burning at any one time, for calculating this drop was determined from the records on the transformer charts; of course the character of the service goes a great way in making this last determination. A separate transformer was placed only when the total annual cost for the placing and maintenance of such transformer did not exceed the sum of the two following costs—the interest on the cost of placing and maintenance of wire necessary to connect the customer to the nearest "bunch" transformer, and the increased cost due to necessary increase in size of transformer. The annual cost of a transformer on the lines was considered to include the cost of the iron losses, figured as costing the electrical lighting station at an assumed rate of one-tenth (.1 cent) per lamp hour of 55 watts, a 5 per cent. interest on the cost of the transformer and the high rate of charge of 10 per cent. depreciation. To faciliate the bunching and loading of transformers in conjunction with other data, the following table is useful:

Capacity in lamps.	Cost of transformers.	Interest on cost at 5%.	Depreciation, 10%.	Leakage.		Cost of leakage at .1 cent per lamp hour, 55 watts.	Total annual cost of transformers on lines 24 hours service.
				Watts.	Watt hours per year.		
10	18.00	.90	1.80	29	254,000	4.62	7.32
15	22.00	1.10	2.20	30	262,100	4.78	8.08
20	26.00	1.30	2.60	32	280,000	5.10	9.00
30	32.00	1.60	3.20	35	306,400	5.58	10.38
40	39.00	1.95	3.90	37	324,000	5.88	11.73
50	47.00	2.35	4.70	51	446,000	8.10	15.15
75	68.00	3.40	6.80	65	569,000	10.33	20.53
100	80.00	4.00	8.00	77	674,500	12.25	24.25
150	112.50	5.62	11.25	85	744,000	13.50	30.38
200	150.00	7.50	15.00	125	1,093,000	19.90	42.40
300	225.00	11.25	22.50	150	1,312,000	23.85	57.60
400	300.00	15.00	30.00	160	1,400,000	25.00	70.00
500	375.00	18.75	37.50	170	1,488,000	27.05	83.30

The principal factor in determining the size of a transformer is the character of the service, a more liberal allowance being made for an overload in a residence than could be made in a commercial district. A good transformer should stand an overload for several hours of at least 25 per cent., and for a shorter period of 50 per cent., or even more.

The lightest load registered during the year preceding the commencement of the reconstruction was 380 amperes. Ten months later, with about 8,000 more lamps wired on the service than at the time of the 380 ampere load, above referred to, the lowest load recorded was 245 amperes, or a decrease in the load line of 135 amperes, this decrease in leakage load being due to transformer changes. The leakage of the 229 new transformers was 19 amperes, which means that the 473 old transformers had a leakage of 154 amperes, or an average leakage of .325 ampere per transformer removed, which figure has been verified by leakage tests made on the old transformers which have been removed from the lines. Thirty-six of the 135 amperes reduction was due to the removal of the 110 old transformers, and placing the customers served from these on other old transformers, making secondary distribution systems. From this is deduced the fact that by replacing the 345 old by 187 new transformers, a saving was effected of 99 amperes. The average saving for the 187 changed is then .529 amperes per change, which with coal at $2.75 per ton, means an annual saving of $25.58 per change in coal alone. The average cost of the 187 changes, including the cost of new transformers, all extensions of wiring for secondary mains and all labor, crediting these orders with old transformers as scrap only, was approximately $65. As stated above an annual saving per change in cost of coal would be effected of $25.58, therefore at this rate the new transformers will pay for themselves, if the saving in coal only is considered, in about two and a half years.

When the 1,160 transformers above referred to have been replaced by new transformers, and the bunching of customers

[1] Abstract of a paper read before the Canadian Electrical Association.

has been carried out, it is estimated there will be but 636 transformers required, and the total leakage will be less than 75 amperes.

Fig. 2, Curve a, represents the average load on the station during the twenty-four hours for seven days, the highest point reached being 760 amperes, and the lowest 380 amperes.

Curve b represents the average load that would have been on the station for the same period had the 917 transformers

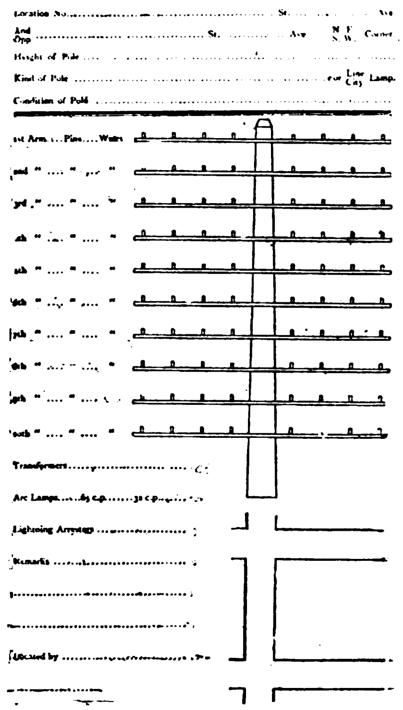


Fig. 1.—Pole Diagram.

been on the lines instead of the 1,160, and the saving of 135 amperes been accomplished.

A decrease in transformer leakage of 135 amperes means a decrease in load of 135 amperes for every hour of operation, which represents a saving in coal, at $2.75 per ton, of about $7,348 per year, that is, for a station running twenty-four hours per day. Apart from this increase in capacity, there is also the saving due to running a smaller engine for the day load, and the consequent saving in labor, oil, etc.

As so much of the advantage to be gained by this decrease in transformer leakage depends upon the kind of transformer used, it would only seem safe and wise to insist on all transformers coming within guaranteed limits for leakage and regulation. The only way to know that transformers come within the prescribed limits is to get them from manufacturers who are known to build the very best transformer, or, better still, test each transformer as it is received from the factory. Inasmuch as transformers made by different manufacturers, and apparently alike in every respect and seemingly identical in construction, are known to vary from 25 per cent. to 100 per cent. from each other, the advisable plan appears to be to test each transformer as it is received. This plan of testing transformers is followed out in many stations and is the only sure means of keeping the leakage within the calculated limits.

The reduction in leakage load so far obtained in the reconstruction under consideration has not been accompanied by any sacrifice of transformer regulation. The type of new transformer used is one giving the best all round results, that is, one in which regulation and leakage are so proportioned in its construction as not to benefit one at the expense of the other. In thickly populated or central business portions of the city, where an extensive secondary distribution is possible, and where large transformers may be connected in parallel at different points, it would be an advantage to use transformers of very small leakage current and high "all-day efficiency," as in this case the transformers share the load between them, and regulation can be sacrificed to gain diminished leakage current. However, as it is only in very large cities, and only in the most thickly populated centers of these that the secondary distribution system can be economically used, the make of transformer giving the best all round results should, in general, be selected. To further improve the regulation beyond that to be obtained by improved transformer regulation it is intended to change the primary distribution from 1,000 to 2,000 volts, thereby decreasing the copper losses on the existing circuits to one-quarter of the present losses, and reducing the feeder drops so that good service and regulation will be obtained without the use of feeder regulators or the erection of additional copper. A source of additional improvement in regulation will be the use of generators with very close regulation. The necessity of transferring the circuits from one dynamo to another makes close inherent regulation in generators an imperative feature if satisfactory service be desired.

Another factor in increasing the capacity and earning power of a plant is the use of an efficient lamp with an economic life. The best known makes of lamps on the market have a difference in efficiency of from 10 per cent. to 15 per cent., which means a difference of from 10 to 15 per cent. in the earning power of the plant, depending on the efficiency of the lamp in use. A 10 per cent. difference in output or capacity should receive consideration.

Lamps with long life are found to be inefficient; very efficient lamps are usually short lived. There is a point between these extremes which makes a lamp suitable for electric lighting station use. Using an efficient lamp increases the earning capacity of a plant and permits of using higher candle power lamps with a proportionally less increase in cost.

It has been determined that lamps which have been made by identically the same process differ in lots. It has been observed that lamps received from the same factory do not average the same candle power and efficiency for different invoices, that is, lamps received in one invoice are generally quite uniform throughout that lot, but they vary considerably from lamps received at other times. From this it will appear that to derive full benefit from using efficient lamps it is necessary to test the lamps and ascertain that they come within the limits of efficiency which have been decided to be the most economical for the local conditions. To determine what lamp is best suited for any electric lighting station, it is necessary to know the cost of producing current per lamp hour, and having established this for any special make of lamp, the following formula will permit of a comparison of different makes of lamps and the determination of the best lamp for the conditions under which they are to run. In considering the cost of production per lamp hour in connection with the lamp question, the cost of service may be divided into three parts:

A. That portion of the service per lamp hour that is practically not affected by the average efficiency and life of the lamps and such portion of the maintenance, operating and generating expenses, as is practically not increased by increasing the current consumption per lamp hour.

B. The cost per lamp hour, coal, water, interest and depreciation on the lines, dynamos, engines, etc., and such part of the expense of the service as increases proportionately to the amount of current served per lamp hour and as the maximum station output.

C. The cost of the lamp per lamp hour, and the expenses per lamp hour for replacing exhausted lamps. This is equal to the cost of one lamp, plus the cost of exchanging one exhausted lamp, divided by the average life of the lamp.

Under the first division (A) should be included the cost of

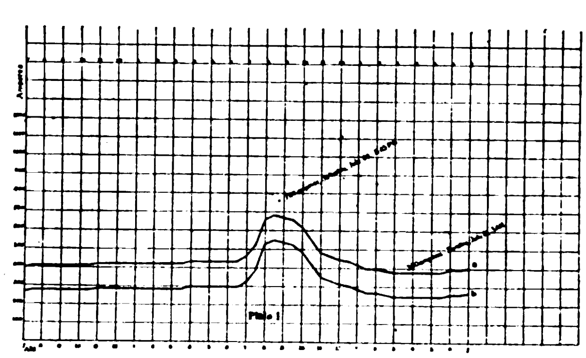


Fig. 2.—Load Diagram with Different Leakage Currents.

fuses, meters, transformers erected, and secondary connections, line construction, maintenance, etc., and such proportion of the operating and general expenses as is not increased by increasing the current consumption per lamp hour.

Under (B) should be included that portion of the cost of service per lamp hour, exclusive of lamp renewals, that increases proportionately to the current consumed per lamp hour.

These divisions of cost should be so made that the sum of A, B and C will represent the total cost of service per lamp hour. The values of A, B, and C representing the above divisions of cost having once been established for a lamp of any

given efficiency and average life for any particular lighting station, the cost of service per lamp hour for this same station with any other lamp which has a current consumption different from the current consumption of the first lamp, and having an average life of "Y" hours, would be A + XB + C. = the cost of service per lamp hour, "X" representing the proportion between the current consumption of the lamps being compared, and "C" being the cost of one of the new lamps, plus the cost of replacing one exhausted lamp, divided by "Y," the average hours of life of the new lamp.

This formula applies for comparing the cost of producing light with lamps having different costs, efficiency, and average lamp life, when they are to be burned in the same plant and under the same conditions of average lamp hours burned per lamp installed, and the same maximum number of lamps burning for a given number of lamps wired. Value (B) in this formula includes the coal consumption and the materials which practically vary proportionately to the watt hours output required for providing the light. It also includes the interest and depreciation on the plant, which must be enlarged when the lamps consume large amounts of current, because the generating and supplying capacity of the plant must be proportionate to the maximum output called for by the lamps. In many plants the interest and depreciation account will form quite a considerable portion of the factor B, and as a large value to the factor "B" makes a showing against the high consumption of current per candle power hour very bad, it would appear that any lamps installed that did not burn at the time of maximum current output from the station could be economically used of a poorer efficiency with longer life than lamps which do burn at time of maximum output, because any additional demand for current on a plant that is not a call for current at the time of maximum output, does not require an increase of plant capacity. In estimating the best efficiency per candle power hour, or per lamp hour, for these lamps that do not burn at the time of maximum output, the cost of interest and depreciation entering into the factor "B" in the formula (in fact, all the costs that increase proportionately as the size of the plant required to serve the lights wired) should be excluded from the factor "B." The result is that lamps that do not burn at the time of maximum output can be economically used of considerably lower efficiency than lamps that do burn at that time.

The outline of the reconstruction contained in this paper and the statement of the results so far obtained are for an electric lighting station serving 60,000 incandescent lamps. Another much smaller electric lighting station has had its transformer system rearranged, within the past year, upon the same plans outlined for the station serving 60,000 lamps. This smaller station had, and still has, a capacity of two 500 light dynamos, serving 2,100 lights wired. At the time of heavy load, the station was loaded beyond a safe limit. Apart from this the demand for an increase in the number of lights wired could not be met. An increase in the boiler, engine and dynamo capacity appeared, to some, the only way to meet the requirements; however, this was unnecessary, as the transformer system was rearranged, and thereby ample capacity to meet the immediate demands was furnished. Prior to this rearrangement there were seventy-nine transformers on the lines, having a leakage of about 20 amperes. The seventy-nine old were replaced by forty-two modern transformers, having a leakage of less than four amperes. By this rearrangement and the substitution of modern for the old transformers, a reduction in load was obtained of 16 amperes which permits of the station not only carrying safely, with the same station equipment, what was formerly an overload, but also permits of an increase in the earning power of the plant of approximately 1,000 16 candle-power lamps.

NIGHT-SIGNALS AT SEA.

Some experiments have recently been made in regard to a new night-signaling apparatus, the invention of a Captain Sellner, an officer in the Austrian Navy. The signaling is carried out with two lanterns, on either of which five different arrangements of red and white lights can be shown, the two together being able to show no less than thirty different combinations. Electric lights are used for the lanterns, and though separate batteries are used for the lights and for the signaling apparatus by which the lights are changed and obscured at will, eventually it is intended that one dynamo shall be so arranged as to supply all the current required. A check on signals sent by the apparatus is obtained by a device by which the message sent is automatically printed by the working of the signals. It was found that no difficulty was experienced in reading the signals at a distance of six miles and more.

MUNICIPAL ELECTRICAL ASSOCIATION OF ENGLAND.

THE first meeting of the Municipal Electrical Ass'n was held in London on June 10-12. The first session, held in the United Service Institution, was well attended, among those present being Sir Courtnay Boyle, Major Cardew, and representatives of all the large electrical manufacturing firms. The papers were read in abstract, which we give below. The president, Mr. Arthur Wright, of Brighton, took the chair and addressed the meeting as follows: Although the objects of the association are generally and very tersely stated in the constitution, I wish to amplify the wording there by stating that, in promoting the special interests of municipal electricity undertakings by bringing together, for the purpose of comparing experiences, the men responsible for their management; we hope to succeed in getting the representatives of the ratepayers to participate in our discussions, and to obtain their valuable co-operation and municipal experience in trying to solve our difficulties, so that our recorded conclusions may receive the greater consideration from the head governing bodies. The problems that have already confronted the management of municipal electrical undertakings may be divided into three distinct groups—those relating to policy, to commercial, and to technical questions.

The group of "Questions of Policy" must obviously include those relating to what should be the proper period allowed for the repayment of loans. That some decision ought soon to be arrived at is evident when we remember that in London the vestries can get permission from the County Council to repay their capital in periods exceeding forty years, whereas in many of the provincial towns twenty-five years is the period fixed by the Local Government Board. Take, again, the question of assessment of electricity works and mains. The interpretation of the law on this point is so uncertain among experts that it is actually possible, in the case of two municipal electrical undertakings in the South of England, for the relative assessments to be nearly as 10 is to 1, although the capital invested is about equal.

The decision arrived at as to what policy should be pursued in relation to the profits obtained, has a great effect on the rapid growth of municipal electricity undertakings.

Another point in connection with the general policy is whether a corporation should make all ratepayers pay a uniform profit on the cost of production of the electricity they individually consume, or charge a uniform price to everybody. I scarcely need add that the two systems cannot both be adopted. The former has the advantage of justice on its side, while the latter has that of greater simplicity.

The wisdom, or the contrary, of municipalities taking joint action in threatened patent litigation, or in view of new parliamentary regulations or restrictions, wants discussion and settlement. The questions whether municipalities should carry out the wiring of private premises in competition with local tradesmen; whether they should have powers to hire out motors, arc lamps, and fittings; the advisability of establishing municipal telephone systems, electric fire alarms, and electric fire engines; the possible benefits of combining the water and electricity works; the use of the plant in periods of light load for the production of such by-products as disinfecting fluids, acetylene, and carborundum, etc., are all interesting problems of policy which, I trust, will be ventilated and argued at our conventions.

With the second class of problems connected with our work—viz., those requiring consideration from a commercial point of view—it seems to many of us quite impossible to get this class of question satisfactorily and adequately discussed before societies, however influential and well organized, which comprise among their members men representing absolutely conflicting interests, and it appears equally futile to discuss these questions before institutions including among the members the managers of electricity supply companies, whose object in developing their business—viz., to get the biggest return on the capital expended—is so entirely different to ours in trying to supply the greatest number of ratepayers at the smallest possible cost.

Under the heading of "Commercial Problems" must come the important question of the proper organization of the electrical staff—that is to say, how to so organize a staff and separate the undertaking into separate departments as to be able to define the duties and responsibilities of each member of it, and to ensure against any discontinuity in the business in case of illness or resignation of the chief officers..

Another most interesting and still unsettled point is what should be the basis on which to calculate the cost of energy wasted in feeders, transformers, etc., for the purpose of determining the relative cost of different systems of distribution. I have not yet succeeded in meeting two men agreed as to how this should be done. Again, it has not yet been generally recognized, as some think it ought to be, that it pays a corporation

to cater in our industry for the same class of people that proves so remunerative to the railway companies—viz., those who choose to travel third class—and that it would probably be very much more advisable for corporations to run mains in their districts than only into the districts occupied by the houses of the rich and often-absent residents or the early-closing shopkeepers.

With regard to the last group of questions, those of technical interest, which to most of us are infinitely more attractive than those of commercial expediency, it is hardly necessary for me to do more than enumerate many of the most pressing problems. Foremost among these, in my opinion, must surely stand the question of what should be considered the best system of distribution of electricity to any particular town or district. That the present state of things cannot be finality is obvious when we bear in mind how numerous are the different methods at present advocated and in use for towns of comparatively the same class. In connection with this battle of the systems must be decided the proper voltage of supply to be adopted by works to be erected in the future, also whether it is advisable, and, if so, in what state of their progress, for works in actual operation to raise their voltage of supply, and the best method of effecting the change. I only wish I could see a chance of our discussing within the next year or so such specially interesting technical problems as the advisability of earthing the neutral conductor of a low-tension system of supply, the most suitable class of mains to adopt, the proper size of feeders and generating units, the advisability of adopting for commercial, if not technical, reasons one uniform periodicity for alternating current plant, the wisdom of interconnecting all the low-tension network of a town, etc.

"ELECTRICITY SUPPLY AT 220 VOLTS."—BY A. S. BARNARD.

The author dealt chiefly with the advantages and disadvantages of the use of 220 volts on the distributing mains, and thought it was probable that many engineers whose stations were at present working at 100 to 110 volts would gradually persuade their customers to take a supply of 200 to 220 volts, which would at any rate be an immense gain to the supply work. He considered that in the majority of cases the change likely to be made would be the doubling of the pressure throughout. The advantages of the changes were, briefly, as follows: (1) existing mains can supply twice as many customers, at the same time reducing the percentage of loss in the cables by one-half; (2) variations and fluctuations due to the switching on or off of motors or large groups of lamps, or carelessness in switching dynamos in or out at the station, are all reduced by at least one-half; (3) new customers can be supplied at a much greater distance from the station. After considering the effect the change would have on present systems, the author proceeded to explain how it would affect the wiring and fittings on consumers' premises. As far as present experience went, there was little, if any, increased danger of fire by adopting 220 volts. In regard to the necessity of a higher efficiency lamp, he adduced evidence to show that 220-volt lamps could be obtained which compared very favorably with the 110-volt lamp.

"ALTERNATING CURRENTS AND HIGH VOLTAGE LAMPS."—BY W. H. COUZENS.

The author's object through the paper was to bring before the notice of the association some of the cases in which high-voltage lamps would prove of service to the alternating engineer. In the first place, it would lead to the extension of the substation system of distribution to scattered residential districts to take the place of distributed transformers; and, secondly, the substitution of increased pressure in these places would be a comparatively simple matter. Alternating current engineers had been slower to take up this question, as it had not been forced so necessitously upon them. He had every reason to believe that the advantages of increased pressure and reliability of lamps would make themselves felt in the near future.

"MUNICIPAL CONTROL OF WIRING."—BY C. H. WORDINGHAM.

Mr. Wordingham gave a short abstract, in which he pointed out that much doubt existed as to what power municipal authorities had for making regulations for the control of wiring, and although it was greatly to be desired that the Board of Trade should assist municipalities he showed that there did not appear to be much prospect of this being done. The authority given by provisional orders was found not to be sufficiently definite for the purpose, and other orders must be obtained. Having mentioned the course adopted by the Glasgow Corporation, he said, although that was good, something more was wanted, and advocated the appointment of the municipal electrical engineer as a kind of consulting engineer. He also advocated a fee being charged. This fee would be small in case of a very small consumer, and, of course, larger for a larger consumer. Among advantages which would accrue from such a course he enumerated that of the security to a consumer in being able to obtain impartial and good advice, and of having his work done under proper supervision instead of the consumer being left to the interested advice of contractors. He felt this was a better alternative to the corporation carrying out the wiring themselves, which course would be far more likely to cause friction. The author proceeded to suggest the various headings under which these rules might usefully be framed, and the paper concluded with two suggested resolutions to be proposed for adoption at the convention for the carrying out of this object.

"COST OF ELECTRICITY SUPPLY."—BY ARTHUR WRIGHT.

The author pointed out that at present no very definite basis had been decided upon by which to calculate the cost of electricity supply, and illustrated the uncertainty on this question by the fact of so many different tariffs being still in existence. He discussed the usual methods of averages and that of Dr. Hopkinson, and as no one had hitherto published the results of applying the latter to actual figures, he proceeded to do so with those of the Brighton undertaking for the year 1895, using two methods, which he submitted were based on Dr. Hopkinson's method. He then discussed how each consumer's proper proportion of the standing charges should be apportioned, and gave the method adopted by the Brighton Corporation in ascertaining this. Having agreed on a basis on which to estimate the cost of supply to any one consumer, he then pointed out that it was possible to make a profit and loss account for each year showing those consumers who proved profitable and the reverse. He then recorded some important conclusions which followed from this analysis of electricity costs, among the most important being that he considered that it was the duty of a municipality to charge on a system of uniform rate of profit rather than a uniform price. He stated that the extremely low price at which electricity could be supplied on the former basis more than compensated for its comparative complication. He stated, in his opinion, that it was erroneous to suppose that the cost of supplying short-time consumers, such as offices, etc., would very much diminish as the business increased, as the cost of this class depended almost entirely on the standing charges, and not on the running costs. As an illustration of the effect of these standing charges, he pointed out that it cost two and one-half times as much to supply a unit to a consumer who used his light on the average one hour per day as it did to another who used it three hours. It was far easier, in his opinion, to reduce the average cost of producing electricity by improving the load factor than attempting to make the same reduction by economizing coal. It was also the small householder and his shopping districts which afforded a more promising field for electricity supply than the residential quarters of the rich, and he pointed out that one of the most important corollaries from this theory of the cost of electricity was that streets could be lighted by electricity cheaper than by any other form of illuminant of the same candle-power, and probably the cost per unit for supplying this class of consumer and basements would not much exceed 1½d.

"CABLE SPECIFICATION AND TESTS."—BY JOSEPH A. JECKELL.

The author said he was of opinion that it was fairer and better both for contractors and corporations if it was clearly stated in the specifications exactly what cable was required, and the tests could then be more conveniently specified. Tinned copper wire having 100 per cent. conductivity could now be obtained. The best way to get over the difficulties of difference between the conductive resistance of cables was to specify the resistance the cable has to have, and the number of strands of which it is to be composed, leaving it to the manufacturers to put in 100 or 98 per cent. of copper as they liked. If a concentric cable was required, care should be taken to specify that the copper resistance of the outer conductor should be the same as the inner. High insulation was not necessary per se, but it was necessary in the case of rubber cables to ensure good material and workmanship. The pressure test was advisable in all cables, but more especially compound ones. The bending test was advisable in specifications for compound cables. With regard to the laying of cable mains, he felt it was an advantage that the makers should lay their own, but should not do the trench work, which would be more conveniently done by the corporation. Whatever tests were specified as having to be conducted at the maker's works should be repeated as far as possible after the cables had been laid and jointed up. The insulation tests would be made after one month's electrification, but there was no reason for this generally accepted time limit. It was advisable, but awkward at times, to obtain a long time guarantee.

"ELECTRICITY WORKS RECORDS."—BY A. B. MOUNTAIN, A. M. I. E. E.

In this paper the author said he only attempted to give an idea of the chief records required. Some such records must

be kept by almost every engineer, and in certain electricity works the necessary clerical assistance was not provided, so that the engineers had not the means of getting the items of expenditure in detail which enabled them to make comparisons with other works. The forms illustrated in the paper were the general records that were absolutely required in the works. The cost-sheet showed the several items to be recorded for one month's expenditure. The time-sheet showed the time of any man, and the cost of such time and the work on which he was employed. The engine-room cost-sheet would give the details required from the engine-room, with the general stores required and the chief points which it was desirable to have a record of. There were also tables to give records of high and low tension mains and plant testing, and a daily log-book, a line-test record, and a consumer's register. There were many engineers, said Mr. Mountain, who had devoted considerable time to the matter of keeping these records and tests, and he thought it would be very desirable for the executive committee to obtain further information as to how electricity accounts should be kept so that a comparison between works might be more accurately made. He suggested that it would be better to get a committee appointed to go into the matter, and bring up again at the next convention a more complete form covering the whole of the points in connection with the subject of his paper. He moved a resolution to that effect. The resolution was agreed to.

"ON THE ORGANIZATION OF AN ELECTRICITY WORKS STAFF."—BY E. T. RUTHVEN MURRAY.

As the success of an electricity works depends in no small degree upon the staff directly engaged in running the plant, the organization of this staff requires considerable judgment on the part of those responsible for their engagement. It behoves the engineer to be particularly careful and far-seeing in engaging a staff to keep the wages item of the standing charges as low as is consistent with safety, since when the output is small this item is a heavy burden on the young station. No hard-and-fast rules can be laid down as to the number of men necessary on the staff, as this will depend upon the individual characteristics of the electricity works. Among other matters to be considered which have a direct bearing upon this are the size of the works, their designs, the system employed, whether a direct-current battery station or an alternating-current supply, and, of course, whether the supply is constant or intermittent. Unless there be a large demand throughout the night for public lighting, or an intermittent demand both by day and by night for motors, the small battery station may be able to give a constant supply with only one watch of men, whereas the alternating-current station will require three eight-hour watches. How many men are required for a watch will depend upon the size of the works; but probably it will be necessary to have at least one engineer in charge, one driver, and one fireman. Regarding assistant engineers, it seems only right and proper to employ them, as one can hardly expect either the engine-drivers or switchboard attendants to have the necessary technical training to enable them to take entire charge of the works during the absence of the chief engineer; moreover, it is obviously necessary to give some one man the general responsibility of the proper working of the station during each watch. In organizing the staff, it is most important that the engineer be allowed to choose or recommend men for appointment, and that the men know to whom they are responsible. It is the greatest mistake for the committee who have charge of the department not to allow their chief engineer a free hand in this respect, and internal troubles in electricity works have often been due to this cause.

On Friday morning, after holding a business meeting for the purpose of electing officers for the ensuing year the convention ended with a visit to Brighton, whose electric lighting is under the direction of the association's first president. After addresses of welcome by Mayor Blaker and Councillor Stafford on behalf of the corporation lighting committee a paper was read in abstract by Mr. A. H. Gibbings, on the subject of "Extensions to Outlying Districts." With the short discussion following this paper the convention was closed.

SHERWOOD, MICH.—The Village Council has granted a fifteen-year franchise for the installation of a complete electric lighting and power plant to Rheubottom & Bond, of Union City, Mich. It is expected that work will begin on the plant at an early date.

MR. S. EDGAR WHITAKER, who was in charge of Professor Elihu Thomson's exhibit at the National Electrical Exposition, has returned to Lynn. His work in demonstrating the apparatus was highly successful and gave great satisfaction to the public and everybody interested.

MISCELLANEOUS.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES.[1]—I.

BY J. A. FLEMING, M.A., D.S.C., F.R.S., M.R.I.

DURING the last four years much time has been spent by Professor Dewar and by me in the prosecution of a joint research on the principal electric and magnetic properties of metals at very low temperatures. Some reference has already been made in previous discourses by Professor Dewar to portions of this work[2], but the special object of the present lecture is to extend these descriptions, and put you in possession of the latest results in this department of the low-temperature investigations. It will be convenient to discuss the several divisions of it in the order in which they have engaged our attention.

One hundred and sixty-seven years ago, Stephen Gray, pensioner of the Charterhouse, in conjunction with his friend Granvile Wheler, stretched a packthread 300 feet long over silk supports and demonstrated that an electrification of the thread at one end spread instantly over the whole mass, but that if metal wires replaced the silk no electrification of the thread was possible. This experiment undoubtedly formed the starting point for the first definite recognition of the necessity for a classification of bodies into insulators and conductors, a distinction which Gray's brilliant contemporary, Dufay, extended and confirmed, and for which he and Desaguiliers coined these familiar terms[3]. Gray's contributions to knowledge as an epoch-making discoverer have received less notice from scientific historians than their real value deserves. It is less easy to state who first noticed that the powers of conduction and insulation were greatly affected by temperature. Cavendish in 1776, however, was perfectly familiar with the fact that warm solutions of salt conduct electricity better than cold[4], and made measurements of the relative resistances of an iron wire and a salt solution marvelously accurate when we consider that his means of measurement was the comparison of electric shocks taken through the bodies to be examined.

Not until after the invention of the battery and galvanometer was it clearly proved that differences exist between the conducting powers of metals; but by Davy, Becquerel, Ohm, Pouillet, Fechner, and others all the fundamental facts were ascertained and the classical researches of Wheatstone and later of Matthiessen gave us the accurate laws and constants of electrical conduction. By these investigations it was shown that in the case of electric conduction through metallic wires of uniform sectional area their total resistance was proportional to the length, inversely as the cross-section, and also proportional to a specific constant for each material called its resistivity. Moreover, it was found that this resistivity was considerably affected by temperature, generally being increased in metals by rise of temperature and decreased for carbon, electrolytic liquids, and many badly-conducting bodies.

Although much knowledge of the behavior of pure metals and alloys in regard to electric conduction has thus been accumulated, we considered that it would be of great scientific interest to examine with care the changes occurring in the conductivity of these bodies, or reciprocally in their resistivity, when cooled to temperatures of 200 degrees or more below the Centigrade zero by the aid of liquid oxygen and liquid air[5]. Knowing the great influence of very small quantities of impurity on this quality, our first attention was directed to obtaining samples of alloys and metals in a state of great chemical purity, in giving to wires drawn from them a suitable form, and in devising a convenient support, or holder, by which the electrical resistance of the wire might be measured when immersed in liquid oxygen or liquid air, either in quiet ebullition in an open vessel or under reduced pressure in a closed one. It will be unnecessary to dwell on difficulties surrounding the preparation of these accurately-drawn metallic wires of pure metals. Suffice it to say that our obligations to Mr. George Matthey, Mr.

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[1]A discourse delivered at the Royal Institution, June 5, 1896.

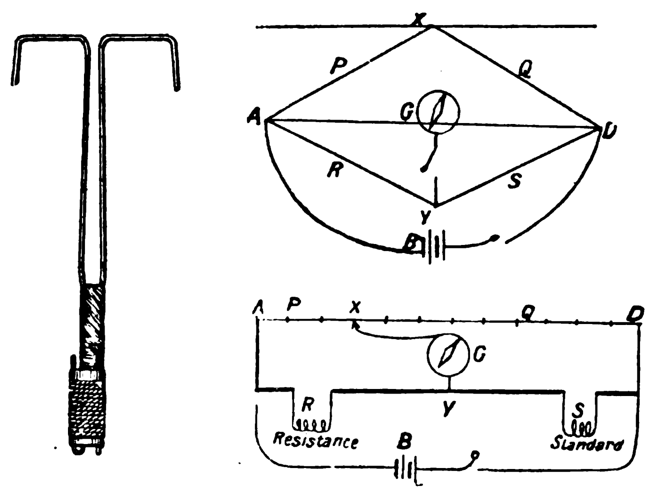
[2]"Scientific Uses of Liquid Air." A discourse by Prof. J. Dewar, LL. D., F. R. S., delivered at the Royal Institution, Jan. 19, 1894.

[3]See "The Intellectual Rise in Electricity," by Park Benjamin. Stephen Gray's papers on this subject communicated to the Royal Society are as follows: "Phil. Transactions," 1720, vol. 31, p. 104; 1731, vol. 37, p. 18; 1732, vol. 37, p. 285; 1735, vol. 39, p. 16; 1736, vol. 39, p. 400. See also Dufay, "Phil. Trans.," 1733, No. 431, p. 258.

[4]See "The Electrical Researches of Cavendish," edited by Clerk Maxwell, p. 234.

[5]Almost the only experimental work previously done in this subject seems to have been that of Cailletet and Bouty ("Journal de Physique," July, 1885) on the resistance of metals at —100 degrees C., using ethylene as a refrigerating agent, and a research by Wroblewski on the resistance of copper at very low temperatures ("Comptes Rendus," 1885, vol. cl., p. 161).

Edward Matthey, Mr. J. W. Swan, and other friends, were very great, with respect to this portion of the work. The final outcome of all failures was the production of a resistance coil of the following form: Two thick wires of high-conductivity copper about 3 mm. or 4 mm. thick are bent, as shown in Fig. 1, and wrapped round the lower part with a cylindrical sheath of thin vulcanized fiber laced to them by a silk thread. On this sheath, which generally had the form of an oval cylinder, a paraffined silk cord was spirally wound so as to leave a helical groove. In this groove was coiled the resistance wire of known length and section, and its ends were attached by solder to the ends of the thick copper leads. The wire was wound a little loosely in the groove so as to allow for the great contraction which takes place on cooling, and yet the wire was exposed, so as to take up instantly the temperature of the bath, whilst at the same time the mass of material to be cooled down was rendered as small as possible. The length of wire employed was generally about one or two metres, and the diameter from about one-twelfth to half a millimetre (.003 inch to .02 inch). These mean diameters were measured by the microscope micrometer at about 50 to 100 places for each metre length of the wire. Having thus prepared a great collection of resistance coils of pure metals and alloys each in the form of a wire of known length and mean diameter, the next operation was the measurement of their resistance at definite temperatures. For the sake of those not fully familiar with the details of electrical measurement, a moment's digression may be made to explain two of the principal methods in use. Becquerel's



Figs. 1, 2 and 4.

work was chiefly conducted with the differential galvanometer. In this instrument two coils of wire of exactly equal length are coiled on one bobbin, in the center of which hangs a small magnetic needle. The current from a battery divides at one point and flows around one path through the conductor under examination and through one coil of the galvanometer. The other portion of the current flows through a wire of variable length, called a rheostat, and through the other coil of the galvanometer, equal in every respect to the first coil, but circulates round the needle in an opposite direction to that of the current in the first coil. Hence, if the currents are of equal strength, the needle is not disturbed at all from its zero position. We can make these currents equal by adjusting the length of the wire of the rheostat so that its resistance is equal to the resistance of the coil being tested. By this means it is easy to verify all the ordinary laws of conduction. We can, for instance, show at once that by warming an iron wire in hot oil its resistance is increased, whereas in warming the carbon filament of an incandescent lamp its resistance is decreased.

This method is not generally so convenient as the arrangement first described by Mr. Hunter Christie to the Royal Society in 1833, redevised ten years later by Wheatstone, in 1843, and which has been always curiously misnamed the "Wheatstone's bridge," even in spite of Wheatstone's own declaration that he did not invent it*. In this arrangement (see Fig. 2) the current from a battery, B, has two paths open to it by which to complete its circuit, and we employ a galvanometer with a single coil to discover two points on these two circuits which are at equal potentials. When these two points are connected the galvanometer needle is undisturbed, and it is a simple matter to show that under these circumstances the numerical values of the electrical resistances of the segments of the two circuits are to one another in simple proportion—that is, P is to Q as R is to S. In actual work, one form which this arrangement takes is that known as the slide-wire bridge (see Figs. 3 and 4), and which is before you. In this construction the battery current flows partly through a uniform wire stretched over a scale and partly through a standard resistance, S, and the resistance, R, to be tested placed in parallel with it. We

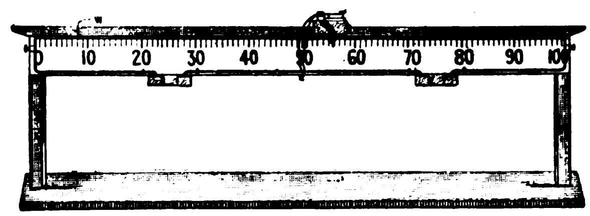


Fig. 3.

employ a galvanometer to connect the middle point between R and S with some point on the slide wire, and we can always find a point on the slide wire such that no current flows through the galvanometer. The ratio of the unknown resistance, R, is to that of the known standard resistance, S, in the ratio of the lengths of the two sections into which the contact-piece divides the slide wire. Hence, R is determined in terms of S. Another form of this appliance, in which all three arms of the bridge consist of coils of wire capable of being joined in series with each other by plugs, is most commonly used, and it was a most carefully adjusted Elliott bridge of this last pattern which we employed.

All our resistance measurements have been reduced to express them in terms of the international ohm as defined by the Board of Trade Committee and obtained by reference to standard coils carefully standardized for us at Cambridge. By this means the whole of our wires were measured at five definite temperatures—viz., at about 200 degrees C.; at the temperature of boiling water, 100 degrees C.; at the temperature of melting ice, 0 degree C.; at the temperature of solid carbonic acid melting in ether, which gives a temperature of about — 78 deg. C., and at the temperature of liquid oxygen boiling under a pressure of 760 mm., which gives a temperature at — 185 degrees C. In this last case the coils were immersed in liquid oxygen contained in suitable vacuum-jacketed vessels. In this connection I should like to express with due emphasis the opinion that none of this low-temperature research would have been possible at all without the assistance of Professor Dewar's most valuable invention, the glass vacuum-jacketed silvered vessel. For much of this work it has been necessary to employ many litres of liquid oxygen and air at a time and to be able to keep it for hours in a state of perfect quiescence and absolutely constant temperature, and in no way could this have been done without this beautiful and scientific device.

Before describing the results of these experiments it may be interesting to exhibit a few of the principal facts. The most striking of them is the very great reduction in electrical resistance or increase in conductivity experienced by all the pure metals when cooled in liquid air. Here, for instance, are two coils of iron wire. Balancing them on the bridge, we find them to be of exactly equal resistance; but if one of the coils is cooled in liquid air, its resistance is reduced to about one-tenth of its resistance at the ordinary temperature of the air. We

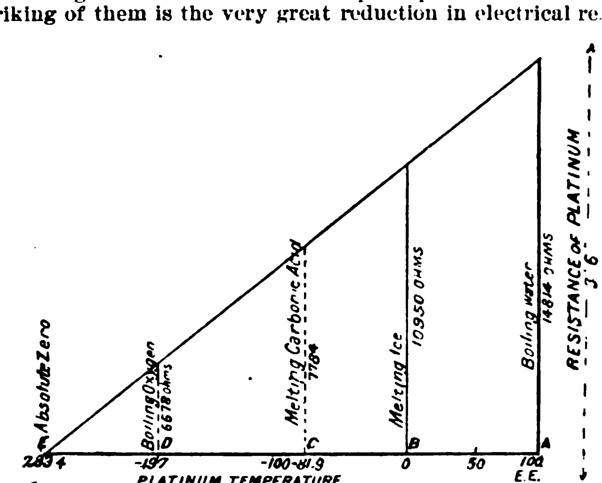


Fig. 5.

*See "Phil. Trans.," 1833: Mr. S. Hunter Christie on "The Experimental Determination of the Laws of Magneto-Electric Induction." See also Wheatstone's "Scientific Papers," p. 129, "An Account of Several New Instruments for Determining the Constants of a Voltaic Circuit" ("Phil. Trans.," vol. 133, p. 303, 1843).

may also compare the resistance of these two similar iron coils when one is placed in boiling liquid air and the other in boiling water. The resistances, instead of being in the ratio of 2 to 1, are now in the ratio of 1 to 12. Again, if we take two wires, one of pure iron and one of pure copper, of exactly equal length and equal section, we find that at ordinary temperatures (15 degrees C.) the iron wire has about six times the resistance of the copper; but if we cool down the iron wire in liquid air to 186 degrees C., still keeping the copper coil at the ordinary temperature (15 degrees C.), we now find that the iron coil has actually become a much better conductor (about 30 per cent. better) than the copper.[7] On the other hand, if we examine the behavior of this coil of German silver, which is a copper-zinc-nickel alloy, or of this platinum-silver coil, we find that the cooling through 200 degrees has but little effect upon its electrical resistance. We thus see that whilst pure metals have their electrical resistance immensely decreased by cooling to the temperature of liquid air, alloys generally do not experience anything like so great a change. A word or two must next be said on the manner in which we have represented graphically all the results of our experiments. We desired to delineate lines on a chart so as to express the change in specific resistance of all our metals and alloys in terms of temperature, and the question then arises, How was the temperature measured? You already know that an ordinary thermometer, whether mercury, alcohol, or air, would be useless to measure temperatures at which even air liquefies under ordinary pressure.

The employment of the constant-pressure hydrogen thermometer with reduced pressure would have given us temperature readings very approximately those of the absolute thermodynamic scale, but the experimental difficulties of its use would have been enormous. We preferred to use the platinum resistance thermometer and to express our temperatures in platinum degrees, as follows. Our experience has shown us that a pure, soft-annealed platinum wire may be cooled as often as necessary to the lowest attainable temperatures, and yet will always have the same resistance when measured again at other constant temperatures. Availing ourselves of this fact, we have used in all this work a low-temperature platinum thermometer made in the following way: A well-annealed platinum wire is made into a resistance coil, as already described. Its resistance is carefully measured at the temperature of boiling water (100 degrees C.) and melting ice (0 degree C.). From these measurements we construct a scale of temperature as follows: A horizontal line (see Fig. 5) is taken on which to mark off temperature, and any two points are taken on this line and divided into 100 equal parts. At these extreme points perpendiculars are set up proportional to the resistance of the platinum wire at 0 degree C. and 100 degrees C. respectively, and through the tops of these perpendiculars a sloping straight line is drawn until it cuts the axis of temperature. The graduation of the horizontal line is continued in both directions on the same scale as the sub-division of the line between the points marked 0 and 100. To measure and define any other temperature—say, for instance, the boiling point of liquid oxygen under a pressure of 760 mm.—we have simply to measure the resistance of the platinum wire in the oxygen. We then look out on the chart the ordinate which has the same numerical value as the resistance of the wire in the oxygen, and at the foot of that ordinate we find a number—viz., (—197—which is the temperature of the liquid oxygen on this platinum scale. Two questions then arise: first, Do all annealed platinum wires give, when used in this way, the same numerical values for definite and identical temperatures? The answer to this is, Nearly, but not quite. In the case of two thermometers much used by us the difference was about half a degree at —100 degrees C., the boiling point of liquid ethylene. Into this matter it is not possible here to enter more fully; suffice it to say that we have invariably reduced our temperature measurements to one standard thermometer. The second question is equally important; it is, What is the relation of the scale of temperature so defined, to the absolute thermodynamic scale, or, which is very nearly the same thing, to the scale of temperature defined by a constant-pressure hydrogen thermometer? If the air thermometer and platinum thermometer readings are made to agree at 0 degree C. and 100 degrees C., then a temperature which would be called 50 degrees on the Centigrade scale would be denoted by 50.4 (nearly) on the platinum thermometer scale, and corresponding to the —78 degrees on the Centrigrade scale, which is the temperature of carbonic acid melting in ether. The platinum temperature by our standard is —81°.9, and corresponding to —182 degrees C., which is very nearly the Centigrade temperature of liquid oxygen boiling at the normal pressure of 760 mm.; the platinum temperature by the same standard is —197 degrees. The conversion of these numbers representing low temperatures in platinum degrees into the numbers representing the corresponding absolute thermodynamic temperatures is a work we have reserved for a future research,[8] but meanwhile it may be said that there is no method of measuring low temperatures which is so easy of application and so accurate as that depending on the use of a platinum thermometer. All our work has been ultimately referred to one standard platinum thermometer, which we call P_1. A suggestion may here be made. There is no reason why the Board of Trade electrical laboratory should not possess a standard platinum thermometer defining officially platinum temperatures, or absolute, for all time, and with which other platinum thermometers could be easily and very accurately compared.

[7]The exact resistances of the coils used for the experiment were as follows: Iron at 16 degrees C. = 7.003 ohm and reduces to 0.711 ohm at —186 degrees C. Copper at 16 degrees = 1.169 ohms; reduces to 0.2033 at —186 degrees C.

[8]Callendar has shown that over a wide range of temperature, from 0 degree C. to 700 degrees C., the difference between the platinum temperature and the air thermometer temperature is a parabolic function of the absolute temperature.

AN EXPERIMENTAL STUDY OF THE ELECTRO-MOTIVE FORCES INDUCED ON BREAKING A CIRCUIT.[1]

BY F. J. A. McKITTRICK.

THE arrangement of apparatus used in the investigation is shown in Fig. 1, in which C is an electro-magnet through which a current is flowing from a battery in the branch A; B represents a galvanometer placed in series with a high resistance in parallel with C at the points F and G; L is an arc lamp.

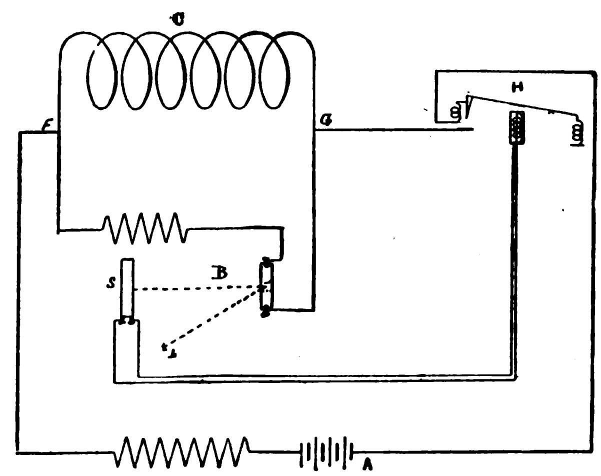
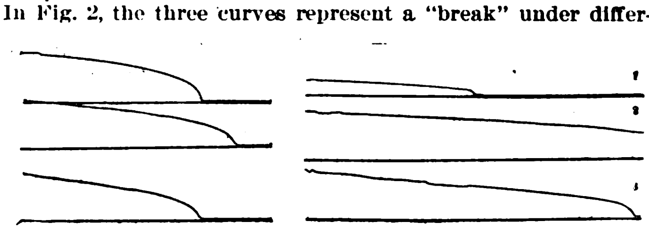


FIG. 1.

and S a slide in which a photographic plate drops; H is a form of circuit breaker placed in A and controlled by an electro-magnet operated by an auxiliary circuit. When a current is flowing in this auxiliary circuit, the terminals in the breaker are held in contact against the force of a spring and the circuit through C is complete. The plateholder, in dropping, aperates a trip which breaks this auxiliary circuit, and hence the main circuit, the effects of the break being recorded on the plate.

Since the phenomenon which we wish to study occurs when the circuit A is broken, it is well to examine what happens when a circuit through which a current is flowing is opened, and by what law the current falls to zero.

In Fig. 2, the three curves represent a "break" under different conditions. The curves are traced from left to right. The three straight lines are the three reference lines, approximately zero lines. Beginning at the left, the straight part of each curve represents the steady deflection of the needle, the distance of this deflection from the zero line being proportional to the strength of the current. The point at which the "break" begins



FIGS. 2 AND 3.

[1]Abstract of a paper read before the Amer. Inst. Elec. Engrs.

is clearly marked by a slight notch. From that point the curves fall away, approaching the reference line quite slowly at first but abruptly at the end. From the point where the "break" ends, the curves run parallel to the reference line.

Fig. 2 (1) is a "break" in which the terminals of the circuit-breaker are of copper; e. m. f. of the circuit is 170 volts, L, the self-induction, .029 henrys, and I, the current flowing before the "break," 5.2 amperes. The time taken by the spot of light to trace out any part of the curve is found by comparing the curve with the vibrations of a tuning fork of known pitch photographed on a plate dropping at the same speed. Since in all cases the plateholder fell quite freely, it can be assumed that the speed of all plates in passing the slit was the same. The duration of the spark in Fig. 2 is in this way found to be .065 second.

Fig. 2 (2) shows a "break" when the breaking terminals were of brass, all other conditions remaining as in (1). The time of duration of the spark is .075 second.

Fig. 2 (3) shows a "break" under the same conditions as (2), except that the spring of the circuit-breaker is strengthened, thus separating the terminals more quickly and hastening the destruction of the arc. The time of duration of the spark is .068 second.

Fig. 3 (2) and (3) show "breaks" with brass and copper terminals, respectively, in which the current is the same as in Fig. 2, but the spring of the circuit-breaker, weaker. The spark in (2) lasts longer than one-ninth of a second, so that its ending is not recorded in the plate. In (3) the terminals are of copper and the spark again ends more quickly than with brass terminals.

No.	*I* in field amperes.	Duration spark.	Induced e. m. f. volts.
1	20.5	.08	430
2	21.2	.07	395
3	11	.05	365
4	20	.08	355
5	32	.08	290
6	42	.14	265
7	20	.02	475
8	20	.02	505
9	32	.03	530
10	32	.02	585
11	11.5	.04	370
12	12	.06	490
13	13	.05	295
14	13	.02	340
15	29	.02	710

From the curves shown above, we gather that the arc formed by a break is exceedingly variable in character and duration, and that the e. m. f.'s induced by the break vary with the arc formed.

We note that the duration of the arc depends upon:

I. The current flowing at the instant of break.

II. The e. m. f. of the battery in the branch A. An increase of the battery e. m. f., other things being equal, always increases the duration of the arc.

III. The speed at which the terminals of the circuit-breaker are separated. Increase in the speed at which the terminals of the circuit-breaker are separated hastens the destruction of the arc.

IV. The metals of which the terminals are composed. We have seen in Figs. 2 and 3 that a break by copper terminals is of shorter duration than a break from brass. A break with zinc terminals does not seem to differ greatly in duration from a similar break with brass. (b) The character of the arc formed varies, of necessity, with any condition that affects the duration of the arc. In particular, however, zinc terminals seem to produce a very irregular arc. (c) The e. m. f.'s induced by the break, as indicated by the induced current flowing through B, vary also of necessity with any condition that affects the duration of the spark. The maximum induced e. m. f. varies with:

(1) The current flowing at the instant of break. (2) The e. m. f. of the battery. (3) The speed of breaking.

During the past winter, experiments were made with the aid of Mr. W. J. Lester to determine the e. m. f. induced in the field of a motor when the current flowing through it is broken. The motor used was a Thomson-Houston, No. 3322, Class 30 R. 500 volts. The field coils in parallel had a resistance of 2.05 ohms and a self-induction of .15 henry. The arrangement of apparatus was the same as in the diagram, described above (Fig. 1). The above table gives some of the results obtained:

MR. S. B. TOLAN has been appointed architect for a new court house to be built at Fort Wayne, Ind., for Allen County. A fine electrical plant will be required.

AUSTRALIA AS A FIELD FOR ELECTRIC SUPPLY.[1]

BY J. A. DAWSON, A. I. E. E.

It may be of some interest to your readers to hear a little on the above subject from an Australian standpoint. There are several important factors to be considered when entering into the question of electricity supply in any part of the world, the chief ones being, I think, the cost of fuel and the selling price of gas, the first having an important bearing upon cost of production of electricity, and the second upon the price per unit which can be charged to successfully compete with our old-established rival.

Now, so far at any rate as the Eastern colonies are concerned, these conditions are decidedly favorable to the electricity supply company. We have an unlimited supply of cheap fuel and the ruling price of gas is very high. Our principal coal-producing districts are Newcastle and Bulli, in New South Wales, and Gippsland in Victoria. The latter mines have only been opened up of late years, and produce a very good coal, though not equal to the Newcastle coal for steaming purposes, by about 25 to 30 per cent., yet it will probably be put on the market in the near future at such a rate as to make it cheaper for Victorian consumption than the imported coal which at present is principally used in all the Colonies, and is now supplied at the seaboard at from 12s. 6d., and inland at 18s. to 25s. and 30s. per ton, according as the distance from the seaboard increases. Then again in most of the Colonies there are supplies of good firewood sufficient for generations to come, the inland cities and towns being practically surrounded by forests, and experience shows that for steam raising purposes four tons of, say, Victorian firewood are equivalent to one ton of Newcastle coal, which is our standard. This firewood can be delivered at the works at from 3s. per ton in some districts to 5s. per ton in others, so that in the far inland towns, where coal would cost, say, 30s. per ton, firewood is substituted which actually gives us fuel equal to coal at 12s. to 18s. per ton, thus keeping the cost of production of electricity very much lower than it would otherwise be. This cuts two ways, as our gas competitor must bring his coal by rail from the seaboard at the higher rate, and must charge a high price for gas—in many places it is 10s. and 12s. 6d. per 1,000 feet—while the Board of Trade unit could be produced at a comparatively low figure, and sold at a high one, say, 1s., thus giving the electricity supply company a double advantage. In the provincial cities of Victoria gas is not less than 7s. per 1,000 feet, and best steaming coal 18s. to 20s. per ton. Electricity should be produced in these cities for, say, 3d., and sold for 7d. or 8d. per unit, and at that rate easily compete with gas and show a good margin of profit. Then, again, many of these cities and towns are important mining centers, with numbers of large payable mines abutting on the leading streets along which supply mains must pass, and these will undoubtedly become consumers both for light and power, and, what is of great importance, will give a steady day load, and thus materially assist in maintaining a good "load factor." Climatic conditions also are favorable, the hot weather experienced in the Colonies making the electric light much more welcome than gas.

A question which is sometimes asked is, Are the existing supply companies in Victoria paying? Detractors say, No. We say, Yes; they are paying, not dividends to shareholders, but a high rate of interest to the banks from which most of the companies have borrowed a large proportion of their capital—a circumstance due to some of the companies commencing operations just about the time of the great financial collapse. Their annual reports show a credit balance over working expenses of from 8 to 10 per cent. on their capital outlay, and each year these companies are extending their mains—to meet the increasing demand—and carrying out other works, all of which have to be paid for out of revenue, and this during a period of financial and business depression, when almost every other industry is languishing. With the return of prosperity, of which there are evident signs, and under the recent Electric Light and Power Act of Victoria, giving supply companies a tenure of 30 years, with option of renewal or selling to Local Authority at the expiration of that time, electricity supply companies will take their right place, and, on the whole, their outlook for the future is very bright.

MR. HENRY F. COTTLE, of Charlestown, has just been appointed chief of the department of electrical construction of Boston, by Mayor Quincy. This department has been only recently created, and as its chief, Mr. Cottle will have general supervision of all the electrical work belonging to the city.

[1] London "Electrician."

AN ELECTRICAL IGNITER FOR GAS ENGINES.

AN ingenious igniting device for gas and petroleum engines has been invented recently by Mr. Arthur A. Hamerschlag, of New York, which we illustrate diagrammatically in the accompanying engravings. The object of this device is to provide a simple and effective means for supplying electric impulses of equal intensity to two or more igniting devices simultaneously from a single source of current in order to accomplish the simultaneous explosion in two or more cylinders of a gas engine.

This can be done either by passing a current through the divided sections of a sparking coil, the igniting devices being

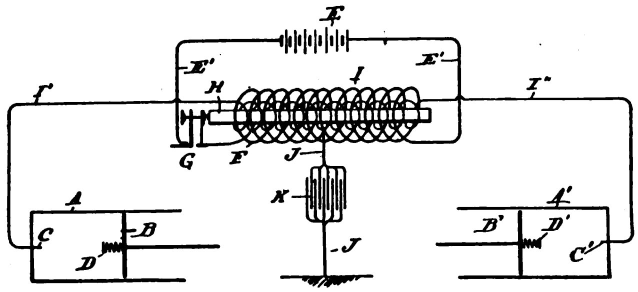


FIG. 1.

in circuit with the divided sections of the coil, by obtaining the impulses from divided sections of the secondary coil of an ordinary induction coil, or by connecting the electric igniting devices in the secondary circuit to a common return connected to the primary coil.

The essential features of the device will be seen by reference to the illustrations, Figs. 1 and 2, which are lettered correspondingly. A A' represent engine cylinders in which the pistons, B B' work. C C' are sparking points, supported in the ends of the cylinders from which they are insulated, and D D' are spring supported contacts mounted upon the pistons, the latter being electrically grounded through the engine cylinders and frames. E is a battery and E' is a circuit wire leading from the battery to the primary circuit, F, of an induction coil. I is the secondary of the induction coil, each end of which is connected to the sparking contacts, C C'. A wire, J, connects one of the central convolutions of the secondary coil with the ground, forming two circuits through the sections of the secondary coil and sparking points of the engines.

The pistons, B and B' operate simultaneously toward and from the cylinder heads. It will therefore be observed that the contacts, C D, and D' C' will simultaneously touch and close or almost touch and close the circuits through the sections of

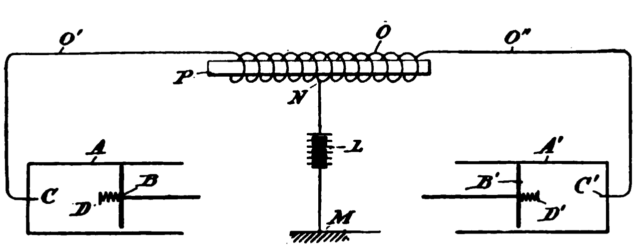


FIG. 2.

the secondary coil, I, and thereby produce sparks in the cylinders, A and A' simultaneously and of the same intensity.

A condenser, K, Fig. 1, is interposed in the ground-wire, J, connected to the center of the primary coil and forming the common return for the igniting devices in the secondary circuit.

Fig. 2 shows a circuit containing an ordinary sparking coil. In this arrangement the battery, L, is grounded at M and connects at N with a central convolution of a sparking coil, O, which is coiled around a soft iron bar, P. The opposite ends, O' and O'' of the coil connect with the contacts, C and C', respectively. It will, therefore, be observed that when the contacts, C D and D' C' engage, impulses will simultaneously pass through the divided circuit and cause sparks of equal intensity between the contact points.

PHENOMENA OF COMMUTATOR RESISTANCE.[1]

BY H. J. EDSALL AND M. C. RORTY.

PROBABLY owing to a belief that commutator losses, outside of friction, were unimportant no investigation of the question had been made until the spring of 1895, when Messrs. Cox and Buck, at Columbia College, experimented upon the effect of pressure in reducing contact resistance and determined the friction losses for different brushes.

Making the natural but unwarranted assumption that the the resistance was the same whether measured by means of one ampere of current or ten amperes, they entirely neglected the effect of varying current density.

The apparatus employed by the writers consisted simply of a commutator 5⅝ inches in diameter, made up of sixty-four hard copper segments, mounted upon a shaft having a pulley at one end to permit its being driven at any desired speed. To secure electrical connection from brush to brush a strip of sheet copper was wound around one end and carefully soldered to each bar. The results for the different pairs of metallic brushes tested were practically the same, and what variations there were in the runs made with carbon brushes may be laid rather to differences in the condition of the commutator surface than to any difference in the behavior of the brushes themselves.

Two typical series of readings were taken for metallic and carbon brushes. These observations were made upon a metallic leaf brush having a contact area of .4 square inch, and a carbon brush of the Eickemeyer type having an area of .2 square inch. The first pair had been in use on a 10 kilowatt bipolar Edison machine and the second upon a twenty-light Weston arc machine. The resistance curves are both hyperbolae, the one for the metallic brushes being equilateral. The behavior of the brushes is best shown, however, by the volt-ampere readings. It was found that the fall of potential is independent of current in the case of the metallic brushes and very nearly so for the carbon brushes. In many cases with metallic brushes the fall of potential was actually greater for very small currents than for the heavier ones. One pair gave 1.6 volts drop for four millionths of an ampere and only .7 volt drop for 50 amperes. The corresponding resistances are 400,000 ohms and .014 ohm respectively. These rather surprising results can only be explained on the assumption that the coating which forms upon the commutator surface is practically a non-conductor, and that each different current tears it apart to a different degree. This theory is supported by the behavior of the resistance when sandpaper is applied to the surface of the commutator. Under such circumstances the voltmeter reading falls practically to zero. With metallic brushes oil produces much the same effect by softening the film.

Besides testing the effect of current density upon the contact resistance runs were made to determine the effect of speed and brush pressure. These seemed to show that mere change in the velocity of rubbing had little or no effect, any increase of resistance with speed being due to increased vibration. These curves for resistance as a function of pressure agreed with those obtained by Messrs. Cox and Buck as to form, which was much like that of the curves for resistance as a function of current. In one case increasing the pressure of a metallic brush from one to six pounds per square inch caused a decrease of only 12 per cent. in the resistance. A pair of carbon brushes showed 28 per cent. decrease in resistance for an increase of pressure from ½ lb. to 5½ lbs. per square inch. It is seen from the above figures that brush pressure, within the usual working limits, is not a very important factor in determining the contact resistance.

The results of the experimental work may be summarized as follows:

1. Mere change in the velocity of rubbing has no effect upon contact resistance.
2. Within ordinary working limits increase of brush pressure causes only a slight decrease of resistance.
3. Sandpaper used occasionally upon a commutator will greatly reduce the losses through resistance.
4. Oil used with metallic brushes materially reduces the resistance, especialy for small currents. The effect is, however, temporary.
5. Both carbon and metallic brushes tend to reach a limiting condition in which the resistance varies inversely as the current.

ELECTRIC LIGHT RACE-TRACK AT CINCINNATI.

A new electric light race-track has been laid out at Rosedale, near Cincinnati. The track is a third of a mile in circumference, and has 1,000 lights, with powerful reflectors. The grand stand, fences, rails and outbuildings are all painted a glistening white, so as to intensify the lighting effects.

[1]Abstract of thesis, Cornell University.

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CONTENTS.

INDUCTANCE AS A NEGATIVE CAPACITY.

THERE is an impression in some quarters that the hoary electrical patriarch—submarine telegraphy—has been in a state of coma for years and that in its lexicon there is no such word a "progress." It is true that the general method of working cables has not changed materially during quite a number of years, but progress in many of the details has been steady and complete. Duplex working, for instance, on the longest cables is now universally successful, while automatic working is being rapidly introduced. The principal obstacle to progress has lain, of course, in the fact that the commercial capability of a given cable, more especially a long one, can only be increased by modifications of the terminal arrangements. The cable itself is constant when submerged, unless a fault develops and lowers the insulation. In some cases this increases the speed of working slightly for a time, but it is usually so troublesome that the submarine companies pray without ceasing for deliverance therefrom.

Nowadays, it is fashionable to make the cores heavier, that is, with more copper, and some remarkably successful trunk cables of this type have been laid recently. It is hardly necessary to say that the capacity of any system is the capacity of its longest section, while another point of great importance is the reserve capacity of the remaining cables in case of interruption of any in that section. The great obstacle to high speed working is, of course, the electro-static capacity, and great efforts are made to decrease this without impairing the mechanical strength or durability of the cable. As stated above, more copper is put in the core even at the expense of increasing the capacity, but this increase is wiped out by the reduced resistance and a lower time-constant is the result.

The veteran scientist, who has just celebrated his jubilee, was probably the first to draw attention to the value of inductance as a negative capacity. Since then Prof. J. J. Thomson has also written on this point, but it has received its amplest development at the hands of Mr. Oliver Heaviside.

The treatment, so far, has been mainly mathematical, and The Electrical Engineer, therefore, thinks it desirable to place before its readers, elsewhere in this issue, some experimental results bearing on this point. The experiments, while not conclusive on the value of inductance in a submerged cable, show that, in a coiled cable, the inductance effect can be made to eliminate the capacity effect. The matter is greatly complicated by the mutual induction of the coils and also by the impulsive character of the charge, as Mr. Heaviside has pointed out. The latter is of the opinion that, in this particular case, it is nearly possible to adjust the cable circuit so that it will act as a mere resistance to simple harmony currents, but his well-known "distortionless" circuit is the only one that will behave like a mere resistance to any sort of impressed voltage. Incidentally, the arrangement shown in the third illustration of Mr. Davidson's article may possible be modified to measure that wily and much-disputed quantity—the effective capacity of a metallic loop. In conclusion, we may point out, that the method adopted throughout has been used frequently in measuring inductances, more especially those of telegraph apparatus, and is another instance of the extraordinary adaptability of the Wheatstone bridge to all kinds of electrical measurements.

GENERAL STREET LIGHTING.

DURING the convention of the Street Lighting Association, held in New Haven, recently, the subject of street illumination was the foremost topic, and this was very fully discussed in all its aspects. One of the facts brought out prominently was that, although street lighting by means of either oil, gas or electricity, has been systematically practiced for a hundred years or more, we still lack a standard by means of which the efficiency of a street lighting system can be judged.

The object of general street illumination is broadly the preservation of public peace and the safety of night travelers,

but not to turn night into day. With this view of the subject it is apparent that there is as much objection to having too much light as there is to having too little, as in the former case, with more than sufficient light, so that one pedestrian may not approach another unseen, it is not only wasteful, but may be injurious in disturbing the natural hours of rest. Assuming this theory to be correct, several conclusions are at once apparent. First, considerable difference in the amount of illumination is desirable in the cases of residence districts, business districts and in the neighborhood of public places of amusement. The opinion seemed to prevail also that it would be preferable to have a uniform intensity of illumination from a large number of small light units rather than a succession of alternate light and dark spots as with lamps of very high candle power placed a considerable distance apart. The question is in this case not so much one of the absolute amount of illumination as that places in the shadows may be light enough in themselves; but to the pedestrian who passes from the glare of a high candle-power lamp into a shaded spot the contrast is so marked as to make the shadow appear for the moment like absolute darkness. While illumination of the business districts is generally easily and satisfactorily accomplished by means of arc lamps at the intersections of the streets, residence districts, especially where a large number of trees are found, are much more difficult to illuminate effectively. The city of New Haven, where the street lighting convention was held, is a good illustration in point. While the amount of light supplied by the arc lamps would be ample if no obstruction existed, yet during part of the year the foliage is so dense as to make the lights almost useless. Trees are certainly important to the beauty of cities and will not be legislated away for the benefit of the town lighting, and the problem remains to divide the light units into a larger number of small ones and place them on poles sufficiently low so that the distribution of light will be uniform under the foliage even if the illumination is in general the less intense.

THE UNDER-RUNNING TROLLEY.

THE upholding by the courts of the underrunning trolley patent has been followed by the filing of a large number of infringement suits by the electrical trust combination, and in several cases settlements have been made by railway companies sued rather than stand the expense and annoyance of a lawsuit. It was to be expected, however, that inventive genius would be soon at work to find new means of establishing electrical contact between the car and the overhead wires, and we illustrate on another page a device for which non-infringing properties are claimed. Whether or not this device comes under the Van Depoele patent is a question which the courts will probably be called upon to decide; but, be their decision what it may, we have full faith in the power of American inventive genius to devise a non-infringing overhead contact-making device, which will be practical in every respect. We have always been in favor of affording the patentee all reasonable protection in his rights and property, but when the possession of a patent is used as a club to compel the purchase of apparatus not covered by patents, then the circumvention of the patent acting in restraint of legitimate trade and competition is to be encouraged and as such welcomed.

Already we note a tendency toward the avoidance of the trolley in the adoption of the third rail on the Nantasket Beach road, and if it prove successful there the future equipment of such roads is hardly a question of doubt. On the other hand, the conduit and surface contact roads are coming to the front with rapid pace. The combine may for a time succeed, but they may, sooner than they expect, kill the goose that lays the golden eggs. We may also recall to convenient memory the history of the incandescent lamp patent and the barren victory achieved in that litigation.

It is a subject for congratulation that at least one large company has thrown down the gauntlet to the Trust and proposes to make a fair fight for business.

ELECTRICITY AS SHE IS TAUGHT.

IN one of the addresses made by Lord Kelvin during his jubilee celebration he remarked that he knew no more of electric and magnetic force or of the relation between ether, electricity, and ponderable matter, or chemical affinity, than he knew and tried to teach to his students fifty years ago, in his first session as professor. What are we to say, however, to this ignorance of the Nestor of electrical science when one of the questions which he still confesses himself unable to solve is expected to be answered by the girl graduates of the Normal College of the city of New York. Here it is: "Explain why a current of electricity is developed in a loop of a continuous conductor when it is rotated in a magnetic field on an axis transverse to the lines of magnetic force." We have not seen any of the replies given to this question, but we venture to say that it was "skipped" in the majority of cases. Nevertheless, it would be interesting to know the views of our aspiring young girl graduates on this all-important topic. We refrain from commenting further on the nature of the other questions employed in this examination and merely draw attention to the employment in three distinct cases of the term "amphere hour!" It is hard to believe that this is due to a misprint, and if such be not the case it is a matter for regret that our young women are launched upon the world with such erroneous notions of even the nomenclature of electrical science.

THE SPECTRUM OF VACUUM TUBE LIGHT.

WE print elsewhere in this issue a contribution from the pen of Dr. W. H. Birchmore, on the spectral properties of vacuum tube light which has a most important bearing on the most recent developments in that field. Scientifically, the interesting part of the experiment described by Dr. Birchmore is the possibility that heatless or nearly heatless light can be produced under conditions of choice by the precipitation of carbon from a very tenuous vapor by splitting the molecule by undulations produced electrically instead of by heat under the conditions previously discussed by him in this journal. Should the precipitation of carbon at a very high temperature and the excessively rapid cooling and re-formation of the molecule taking up the heat thus generated, prove to be the solution of the phenomena, it will be very interesting; at any rate, one more step has been taken in the direction of heatless lighting. The statement that the disturbance was magnetic in its lines of force within the closed tube is not to be taken as a demonstrated fact, but only as a probable explanation of the phenomena. Should a rigid investigation prove it true, a new means of investigation into the phenomena of light will have been reached.

ODYLE AND X-RAYS.

MANY have been the theories advanced to explain the phenomena of the Röntgen ray, but perhaps the quaintest which has thus far come under our notice is that which is put forward by a contributor on another page, who finds Von Reichenbach's "odyle" all-sufficient to account for everything that the Röntgen ray has accomplished. We print the communication as much as an illustration of the peculiar speculations which the X-ray has called into life, as to recall to memory the work of Von Reichenbach, which created quite a sensation at the time of its appearance, just fifty years ago, but which has long since been classed among those speculative works based rather on imagination than on facts.

ELECTRIC TRANSPORTATION.

THE EFFICIENCY OF COMPRESSED AIR FOR STREET CAR MOTORS.

BY GEN'L HERMAN HAUPT, PRESIDENT GENERAL COMPRESSED AIR COMPANY.

MY attention has been directed to an article under the above caption in The Electrical Engineer of June 10, 1896, by Mr. Robert Lundell, in which the writer declares his object to be "to remove confusion from the minds of the readers of Mr. Herman Haupt's book."

Mr. Lundell may be an expert electrical engineer and a profound mathematician, but he has much to learn in regard to the practical applications of compressed air, and a visit to Rome, N. Y., where the Hardie motors have been in use for eighteen months, or a conference with such compressor experts as William L. Saunders, of the Ingersoll-Sargent Drill Company, E. Hill, of the Norwalk Iron Works, or the officers of the Rand Drill Company, would have convinced him that they do, can continue to do, and will give reliable guarantees to do, that which Mr. Lundell demonstrates to his own satisfaction to be impossible by algebraic formulas, calculus, and logarithms. I will not attempt to review the figures, but will point out some of the errors and will simply state that the claims of the Hardie motor are based upon more than twenty years of experiment, tests, observations and development by educated and competent engineers and verified by a score or more of the most eminent engineering experts in this and other countries.

That 300 cubic feet of free air will run an eight ton Hardie motor one mile has been demonstrated by actual tests where the average of many runs on a poor track at usual speed was 298 cubic feet of free air per mile. The Rome motors require a little more in consequence of a change in the valve; but the tests made by Captain Fiebeger, of the U. S. engineers, by instruction from the Commissioners of the District of Columbia, gave an average of 308 feet with a motor of 8½ tons. Mr. Lundell thinks that to obtain the same results in speed, etc., "under street railway conditions the horse-power must be at least doubled," evidently assuming that increasing the speed and doubling the horse-power will double the consumption of air." This is a very common error. The consumption of air is increased by increase of the resistances to be overcome, but is very little affected by speed, within ordinary limits. The journal resistance, which is far in excess of all other resistances to a train, is given by Wellington and other writers at eight pounds per ton on a railroad car in ordinary conditions, and this resistance is very slightly increased for speeds of from 10 miles per hour to 40 or 50 miles. The theoretical horse-power in which time and distance enter as elements, is increased; but not the resistances, or the consumption of air proportionately.

To settle this question absolutely, so far as the Hardie motor is concerned, I requested Mr. Hardie to make a series of actual tests, and I have now before me tables of twenty-five tests with loads of 19,150 pounds, 24,990 pounds and 36,000 pounds, the latter with trailer. The speeds varied from three miles per hour to 22.8 miles per hour. The results were very variable, showing that the differences of speed did not affect the resistances sufficiently to be indicated with any accuracy on the ordinary pressure gauges. For example, at 3 miles per hour the readings of the gauge gave 347 cubic feet of free air per mile, at 5.7 miles 334 cubic feet, at 10.30 miles one reading gave as low as 275 cubic feet, at 13.7 miles 447 cubic feet and at 22.8 miles 445 cubic feet. With the load of 36,000 pounds and speed of 15.34 miles per hour, the consumption of air was only 334 cubic feet. These tests were made on the same track and under like conditions, and the average of the whole was 373 cubic feet.

The gauges are not sensitive enough for accurate determination; but where a charge of, say, 2,000 pounds is put in a motor reservoir of given capacity and the motor runs for a given distance with a known reserve at the end of the run, it is folly to assert that we do not know the average consumption of air per mile or to attempt to prove by intricate calculations that we cannot do that which has been done thousands of times and is being done daily. Let those who doubt take a trip to Rome and satisfy themselves. Opportunities for examination have never been refused, although some parties have used them to try to steal an idea and get up an opposition.

Mr. Lundell gives an elaborate calculation on the efficiency of air compression to demonstrate that to compress 3,600 cubic feet of free air per minute to 2,000 pounds will require 2,480 horse-power. Any of the manufacturers of first-class compressor plants will contract to perform this service at about one-half of this calculated horse-power and guarantee the result. This should be accepted as conclusive. Facts are stubborn things and facts established by the experience and observation of years cannot have their evidence impaired by any number of theoretical computations. We affirm what we know and prefer to prove assertions by practical results rather than by figures. It is said that figures cannot lie, but it is quite certain that they can mislead, of which the article under consideration is an evidence.

NEW YORK STATE CIVIL SERVICE EXAMINATION FOR ELECTRIC RAILROAD EXPERT.

We print below the questions used in the examination just held for electrical expert to the New York State Railroad Commission:

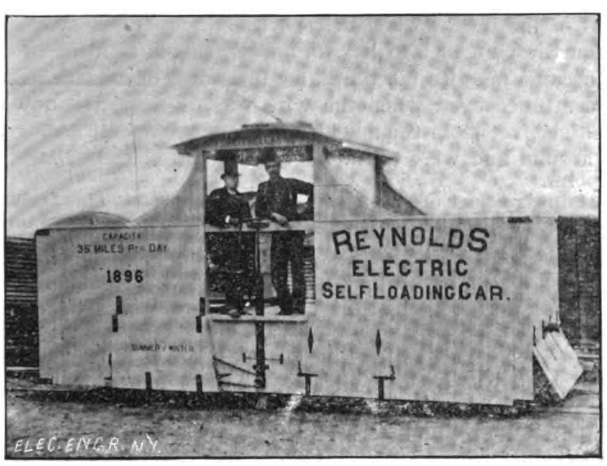
1. State your age, education and experience in the electrical business. Give details of positions held and duties performed, with time and place.
2. Give names of your present and former employers in electrical work, with addresses.
3. What type of electric generator is generally used in the electric railway power house of to-day?
4. When more than one generator is used what practice is generally followed in their operation?
5. Give sketch showing connections of two railway generators when operating on the same circuit.
6. Give list of the protective and controlling devices on a railway generator switchboard with sketch showing connections of same.
7. (a) What method would you employ in insulating generator base from foundation? (b) Why?
8. How would you quickly ascertain that the generator and switchboard operating devices were properly installed, and insulated from ground, while generator is in operation?
9. How would you ascertain if generator and switchboard operating devices are properly insulated from ground when generator is not in operation?
10. What would be good practice in supporting, locating and insulating wires from railway generators to outside circuits?
11. Explain methods employed to build up a generator when it fails to generate when running at normal speed.
12. Give full description of your method of figuring the amount of copper necessary for an even distribution of power on a trolley system with 10 per cent. loss in lines.
13. What drop in potential does good practice allow in the rail and ground return?
14. Complete the connection between the overhead supply circuit and the return circuit through the car, with list of articles employed therein.
15. What safety devices should a motor car be equipped with, electrically?
16. What safety devices should a motor car be equipped with, mechanically?
17. What is your opinion of speeds for electric cars in cities of the second and third classes?
18. What is your opinion of fenders?
19. What is a guard wire for electric street railways?
20. What is your opinion of the utility of guard wires?
21. (a). What is the cause of shocks being received from electric railway tracks? (b) What is the remedy?
22. Give length and type of car, in your opinion, best adapted for ordinary street railway practice in cities of 100,000 to 500,000 inhabitants.
23. (a) What, in your opinion, is the best method of returning the current on a horse car road which is to be equipped electrically and is laid with flat rails on stringers, if such rails have an iron plate under each joint? (b) If no plates are under joints?
24. What direct current potential would you consider dangerous to human life, and what in the case of the alternating current?
25. Explain the electrolytic disintegration of underground metallic conduits, by reason of leakages from railroad circuits. A complaint is made that a water pipe in a street upon which there is a trolley road is suffering from electrolytic corrosion. How would you determine whether the alleged corrosion was partly or wholly caused by electrolysis, and how would you determine the length of time the pipe would last under such action, and what means would you suggest for its partial or complete prevention? Should there be any communication between the rails and water or gas pipes, and if so, at what point?
26. To what would you connect the ground bus of the central station? Would you advise positive or negative terminals of dynamos to be connected to ground, and give your reasons?
27. What is meant by over compounding, and what is its function in practice?

28. Describe the chief functions of a series parallel controller for street car motors.
29. How does the fluctuating character of an electric railroad load affect the choice of engines as regards condensing and non-condensing?
30. What factors determine the speed of a motor, and what factors determine its power? Give complete details and formulas.

REYNOLDS ELECTRIC STREET SWEEPER.

An electric self-loading car has been patented by Mr. A. J. Reynolds, of Montreal, for the purpose of cleaning the streets and automatically removing the sweepings. The accompanying illustration shows the first car manufactured at Deseronto, Ontario, at Rathbun & Company's works.

The system of cleaning is as follows: About one-third of the surface of the street is swept from the curb towards the railway tracks by the ordinary horse sweepers. The refuse is then taken up by the self-loading car at any desired speed and conveyed to the desired location. The car shown is 22 feet in length, 8 feet wide and 9½ feet high, very compactly and strongly built. It is fitted with all the electrical appliances common to a regular trolley car. Contrary to general use the brakes, motors, etc., are all situated above the wheels and axles so as not to impede the full action of the brush. The operating platform on which the persons stand while directing the motion of the car and broom is 8 by 5 feet, and so placed as to prevent them from being touched by the dust thrown from the revolving brush.



Reynolds Electric Self Loading Car.

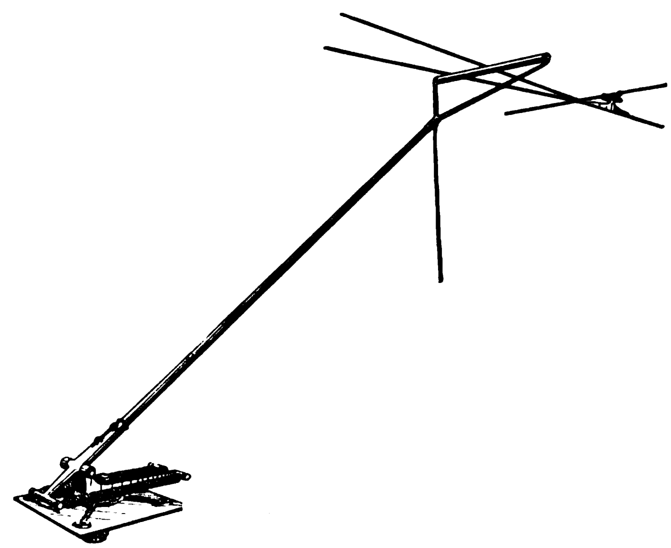
The revolving brush is placed across the center of the sweeper and is covered with steel casings which are provided with proper outlets for discharging the sweepings from the ground into the car body. The casings are also provided with rubber aprons which fit close to the pavement. The high speed of the brush forms a powerful suction, which takes up all the finely divided matter and deposits it over the brush into the body of the car, which is provided with pivoted dump floors for dropping the load instantly at any point desired. The brushes, steel casings and rubber aprons are so constructed as to work in either direction automatically. The cars are driven by a motor placed directly over the brushes on the operating platform of the car, the brush being operated from a counter-shaft by sprocket wheels and chain. The brush makes five revolutions to one revolution of the car axle, is carried on a solid heavy shaft, and is arranged so that it always fills the case which contains it. This is effected by a simple but ingenious device by means of which the casing is altered in size to suit the changes made by the wear on the brush by the pavements. The broom acts equally well running in either direction, steel deflectors being so arranged that it can be run backward without making any change in the adjustment of the machinery or even without touching it. The car can be unloaded in thirty seconds, one man doing the whole work by manipulating a lever. The car illustrated is equipped with two 30 horse-power motors, and its estimated capacity is 45 miles of street cleaning per day. It will pick up 50 carloads of sweepings without stopping. Where the street conditions will permit, the machinery may be made wide enough to cover the whole street, and it may also be made of any length desired.

The cost of operating this electric sweeper is claimed to be about $3 per mile. The side sweeping by horse machines can be done for $1.50 per mile, which makes the total cost $4.50 per mile.

THE NEW WALKER TROLLEY.

The accompanying engraving illustrates the new type of trolley base and trolley contact just brought out by the Walker Company, which, it is claimed, not only avoids existing patents, but possesses advantages not possessed by the form of trolley now in general use in the United States.

It will be noted in the first place that the trolley wheel is dispensed with and in its place there is substituted a long horizontal contact cylinder fixed at the upper end of the pole. This cylinder is mounted on ball bearings, and, therefore, requires no oiling whatever. On account of its width it will be evident that even the maximum lateral motion which the car may receive will not cause the trolley contact to leave the wire, and hence it is unnecessary to provide for any lateral adjust-



The New Walker Under-Running Trolley.

ment of the trolley base, which, as will be seen, is so arranged that the trolley pole can move in a direction only in a vertical plane, without lateral motion.

One important advantage of this trolley is that no overhead switches are required, the width of the trolley contact permitting it to ride over easily to any branch line in the overhead system. The well-known troubles with the grooved wheel at switches and curves are thus avoided, and the repairs at these points obviated.

Many European electric railways are equipped with an analogous type of underrunning contact, and from the results obtained abroad it appears quite probable that its introduction in this country on an extended scale may be looked for at an early date.

WEED KILLING BY ELECTRICITY.

A communication from Mr. J. F. Wallace, Chief Engineer of the Illinois Central Railroad, is published in "The Railroad Gazette," and contains an account of some experiments carried out by that gentleman in the direction of destroying weeds and grass by means of an application of electric current to them. The apparatus, which was used in a small way experimentally, consisted of a wire brush about ten feet long and four inches wide, suspended from a frame on the end of a flat car upon which the dynamo and necessary electrical equipment were carried. This car was hauled by a locomotive, which also supplied the steam for the electric plant.

The brush was connected to the dynamo circuit and moved slowly along the track in contact with the vegetation, the theory being that the vitality of the plants would be destroyed by passing the current through them to the ground. The apparatus traveled over the track at the rate of about four miles an hour. When the experiment was made it was found that the thick Bermuda grass was apparently not affected at the time, but on the day following the application of the current it was dried up and quite dead. Also milk weed and other vegetable matter in which there was a large percentage of moisture

would, when brought in contact with the brush, absorb the current and be killed, while the drier grass which came in contact with the brush at the same time would not be injured.

More extended experiments would, of course, have to be made in order to determine the amount of amperes, voltage, etc., required to give the most economical and efficient results; and it would be necessary for the machine to completely kill vegetation inside of the rails and for a space of three to four feet on each side, and be able to do so continuously at a rate of five or six miles per hour, in order to do satisfactory work.

The advantage of this method of destroying vegetation is in the destruction being absolute. The partial destruction accomplished during the above mentioned experiments would not, according to Mr. Wallace, be satisfactory.

RAILWAY EXTENSION IN MAINE.

Superintendent Hawken, of the Rockland, Thomaston and Camden Street Railway, has completed the new extension of the electric road up into the town of Thomaston, Me. The first car, decorated with flags and bunting, and with a band of music on board, made the first trip into the town on June 16. All of the Thomaston people are greatly pleased, as, for three years, on account of the opposition to the road of a few prominent business men, they have been obliged to walk up the steep Mill Creek hill. This piece of road is considered the best in the State; it was pushed to completion in a very few days. The ballast for this road is composed of lime rock chips and gravel. The Rockland, Thomaston and Camden Street Railway have also completed this season a new electric line from Main street, Rockland, to Tillson Wharf. One car does the work on this line, leaving the end of the line every ten minutes. It connects with all boats and will prove a great accommodation to all summer tourists.

A RAILWAY RUN BY GAS.

Zurich has an interesting electric street railway 1½ miles long. The novelty consists in that the power to generate the current is obtained from gas engines run by Dowson fuel gas. This is one of the first instances in which gas engines have been used for such work.

SOCIETY AND CLUB NOTES.

INTERNATIONAL CONGRESS OF ELECTRICIANS IN SWITZERLAND.

Utilizing the opportunity presented by the holding of the National Swiss Exhibition at Geneva, the Swiss Society of Electrical Engineers is organizing an International Electrical Congress, to be held from August 4 to 9, next.

An invitation to this Congress has already been sent to the American Institute of Electrical Engineers, New York; Elektrotechnischer Verein, Berlin; Elektrotechnischer Verein, Vienna; Institution of Electrical Engineers, London; Société Belge des Electriciens, Brussels; Société Internationale des Electriciens, Paris; Verband Deutscher Elektrotechniker.

Information relative to the Congress will be given to all who inquire at the office of the International Electrical Congress, Université, Genève.

The programme of the congress includes discussions of the following subjects: Magnetic units, photometric units, transmission and distribution of power for great distances by means of direct currents and by alternating currents, protection of high pressure overhead electric lines against atmospheric discharges, and various disturbances caused by electric traction.

This programme will be followed by an excursion which is intended to include a visit to the principal electrical installations in Switzerland.

MARRIED.

MR. LUDWIG GUTMANN was married to Miss Emma Wilkins, at Chicago, June 24.

PERSONAL.

MR. T. C. MARTIN, on June 19, delivered his Niagara lecture at the Royal Institution, London. Lord Kelvin presided and among the many distinguished auditors present were Sir Douglas Galton, Sir Frederick Bramwell, and M. Moissan.

ROENTGEN RAYS.

ARE X-RAYS ODYLIC RAYS?

BY S. F. O'REILLY.

PROFESSOR CROOKES claims to have discovered a fourth state of matter, namely, radiant matter, the three previous states being gaseous, liquid and solid. Röntgen is said to be the first to depict by electrical means a photograph on a sensitized plate, despite the intervention of a solid body. The ray which produces this is called the Röntgen or X-ray. Mr. Edison advances the theory that the Crookes tube in which the Röntgen ray is formed is simply a converter of electrical energy into Röntgen energy; but they have all forgotten one element well known, namely odyle. It emanates from all things and is probably a fourth state of matter. It has been found abundantly wherever chemical action takes place, particularly in electrically excited bodies, having, like the magnet, polarity, but without the power of attraction or repulsion. The appearance of the X-ray is not the first time that odyle has been mistaken for something else and misnamed.

Baron von Reichenbach is the author of a book published in 1846 which will throw light on the subject and will probably be of interest to X-ray promoters. On page 131 he describes an experiment. A lady placed in a dark room and holding the end of a wire twenty feet long, connected to a static machine outside the room, saw flames arise from the free end of the wire to a height of ten inches when the spark of the machine was only one-fourth of an inch in length, and when the rotation of the disc became more rapid, the flame increased to greater height and continued even when the wire was disconnected and removed six feet from the machine. These flames diffused coolness around and were not attracted, like an electric spark, to any point.

In the retrospect of the same chapter he says: "The feeblest chemical action sufficed to develop the new force abundantly, to charge other bodies with it, to excite polarity and to produce light visible in the dark."

On page 165 he gives the new discovery the name of "odyle" and claims that it emanates from all matter. That from electrolytic action he calls electrodyle or electrod; from the magnet, magnetod; from the sun, solod; from the moon, lunod, etc., the universal name being pantodyle.

He discovered that odyle has polarity, that heating a body excites + odyle and cooling — odyle, for which he uses the signs + O and —O. All kinds of fire diffuse —O.

On page 211, he says that odyle has an existence independent of magnetism or electricity. In the dark it gives a bluish or bluish-gray light from its north pole and a yellowish-red from its south pole. Odyle can be conducted by a wire, but much more slowly than electricity and faster than heat or about as fast as the movement of the hand. Bodies can be charged with it, but it takes several minutes to see the charge effects.

On page 214, he speaks of odic rays and found that they pass through solid matter, but with less facility than magnetism. The light diffused by odylically excited bodies is exceedingly feeble, and it is probably on this account not visible to every eye. A person of moderately sensitive vision might remain two hours in absolute darkness before the eye could see odyle.

Reichenbach also states that a hollow ball of metal glows when charged with odyle; a variety of shades of light are seen, the golden yellow being the most intense.

On page 378 he describes experiments made with a magnet on a vacuum tube. Light was seen by a blind man and others. All light disappeared when air was admitted and also when extreme rarefaction was produced. When the experiment lasted long the whole vacuum was filled with odylic vapor, the tube itself fluoresced and the fluorescence lasted after air was admitted. "Steel in this light became as transparent as window glass." He speaks of odylic smoke and ray; the flames are affected by the pressure of the atmosphere and under diminished pressure they increase considerably in brightness. The glow in the vacuum produces no smoke externally and appears inside up to a certain point of rarefaction beyond which it diminishes and disapears.

Now I perceive in the fluorescence of the X-ray tube just these phenomena. The X-ray glow is odylic smoke. The X-ray is odylic and to Von Reichenbach belongs the honor of being the discoverer of the ray which makes solid matter transparent. Verily, "there are more things in Heaven and earth, Horatio, than are dreamt of in our philosophy."

THE ROENTGEN RAYS AND OPTICALLY ACTIVE SUBSTANCES.

BY PERCY F. FRANKLAND.

In an article in "Nature, by Professor J. J. Thomson, it is suggested that the leakage of electricity through non-conductors under the influence of the Röntgen rays is "due to a kind of electrolysis, the molecule of the non-conductor being split up, or nearly split up, by the Röntgen rays, which act the part played by the solvent in ordinary electrolytic solutions." It has occurred to me that if such ionization really does take place, independent evidence of it should be obtainable in the case of optically active substances by a change in their rotatory power taking place when they are exposed to the X-rays, as it is well known that the ionized molecules of active compounds are possessed of very different activity from the undissociated molecules themselves. To put this point to the test, Mr. MacGregor and I have polarimetrically examined two optically active compounds, ethylic dibenzoylglycerate and methylic acetylglycerate, interposing a Crookes focus tube between the polarizing Nicol and the column of active liquid; but although the discharge was maintained in both cases for three-quarters of an hour, there was not the slightest change in the rotation observable. To facilitate the passage of the rays, we employed a thin microscope cover-glass to close the polarimeter tube at the end nearest to the Crookes tube, and that the rays were actually traversing the column of active liquid was demonstrated by obtaining a photographic effect at the other extremity of the tube, whilst the efficiency of the Crookes tube was further proved by the favorite test of the skeletal photograph of a hand, which yielded an impression of great sharpness and exhibiting a most remarkable amount of detail. It would appear, therefore, that the Röntgen rays either do not give rise to any ionization at all, or that the concentration of the ions is so small as not to be detectable by means of a sensitive polarimeter. I have previously shown, in conjunction with Mr. Pickard (Trans. Chem. Soc., 1896), that the active bodies in question exhibit what appears to be a process of ionization when dissolved in certain organic solvents, which process is accompanied by a very conspicuous change in their rotatory power, so that they appeared to be specially adapted for testing this suggested influence of the X-rays.

Incidentally we have roughly tested the relative opacity of a number of organic compounds to these rays by spreading approximately equal thicknesses of each on a number of microscope cover-glasses, which were placed on a photographic plate inclosed in a black envelope, and then exposing them all simultaneously to a Crookes tube placed a few inches above. Out of nearly forty organic compounds belonging to both the fatty and the aromatic series, the only ones exhibiting any marked opacity contained iodine, bromine, or chlorine, the iodine compounds being the most and the chlorine compounds the least opaque. Thus methyl iodide, ethyl bromide, ethylene iodide, ethylene, monobromacetic acid, tribromacetic acid, bromobenzoic acid, and trimethylenebromide were very markedly opaque, and curiously monochloracetic acid was much more distinctly opaque than either dichlor or trichlor-acetic acid.—"Nature."

A PHOTOMETER FOR ROENTGEN RAYS.

All those who have had occasion to use Crookes tubes to produce Röntgen rays will have noticed the extraordinary variations in the intensity of the radiation produced by an apparently trifling change in the vacuum and the make and break of the coil. A useful step toward some quantitative measurement of the intensity of Röntgen rays has been made by M. Meslin, who, in the current number of the "Journal de Physique," gives an account of a photometer for the rays. The principle on which this photometer depends is the matching of the brilliancy of the two halves of a circular patch of barium-platino-cyanide, one-half being rendered fluorescent by Röntgen rays, and the other rendered fluorescent by the light rays proceeding from some standard source, such as a candle or lamp. The light is passed through a colored glass, so that the fluorescence produced has the same tint as that produced by Röntgen rays. The author finds that the barium-platino-cyanide, under the influence of Röntgen rays, fluoresces with a light of such a color that the maximum brilliancy occurs for a wave-length of about 0.500 μ. The barium-platino-cyanide fluoresces most strongly when exposed to light having a wave-length of about 0.460 μ. By means of this arrangement the author has been able to verify the law that the intensity varies inversely as the square of the distance, the following numbers being obtained:

Distance of photometer.	mm.	mm.	Quotient.
From luminous source	350	410	0.853
From source of Röntgen rays.......	54	63	0.857

DARKENING OF THE CATHODE IN A CROOKES TUBE.

BY FLORIAN CAJORI AND WILLIAM STRIEBY.

A pear-shaped Crookes tube with a cathode disc in its narrow end has been used extensively by us during the past ten weeks in private experimentation and in public lectures on Röntgen rays. In common with many other experimenters, we have observed that after much usage the glass opposite the cathode disc and the glass about the anode became darkened. But we do not recall having seen any statement recorded regarding the darkening of the cathode disc. When we began using the tube the surface of the aluminum disc was uniformly bright throughout; now there is on the surface facing the broad end of the tube a dark brown ring concentric with the disc. This ring has an internal diameter of about 6 mm., and is darkest near its inner edge, the densest portion being, perhaps, 1 mm. across. Outside of this darkest portion the ring fades off gradually toward the outer edge of the disc. Taken as a whole, the internal and external diameters of the ring are about 5 mm. and 11 mm., respectively. The circular area inside of the dark ring is the brightest part of the disc. The diameter of the disc is about 17 mm.

During the discharge through the tube we now observe what we did not notice before, viz., a pencil of faint bluish light emanating from the circular area of the disc inside the dark ring. The pencil is normal to the disc. The light resembles the blue or purplish light about the anode. The cylindrical pencil is most distinct at the disc and gradually fades away and becomes invisible at a distance from it of about 2 or 3 cm. If, by reversal of the current, the disc is made the anode, then the pencil of blue light cannot be seen, but almost the entire tube is filled with the same purplish light. Sometimes this purplish light fills the tube also when the disc is used as a cathode. In such cases the discharge at the spark gap (placed in series with the tube) is fat and noisy; the tube shows very little fluorescence and the radiation of Röntgen rays is greatly diminished. —"Science."

EDUCATIONAL.

ELECTRICAL COURSE AT THE WISCONSIN UNIVERSITY.

WE are in receipt of the catalogue of the University of Wisconsin, containing a résumé of the courses of instruction for 1896. In the department of electricity, in charge of Profs. J. E. Davies and D. C. Jackson, the electrical laboratory is well supplied with exact scientific and commercial instruments. With the additional space and apparatus which is allowed through the generosity of past legislatures, the equipment has been made unusually complete in the line of continuous current, and single and multiphase alternating current generation and distribution, and commercial electrochemistry. The dynamos in the laboratory are arranged in a large special room, with a special engine of exceedingly close speed regulation. For use in testing dynamos, all necessary apparatus, including a Brackett cradle dynamometer is at hand. A photometer room is well arranged for the commercial comparisons of arc and incandescent lamps, or for scientific investigations.

ELECTRICAL ENGINEERING AT TULANE UNIVERSITY, NEW ORLEANS.

THE Tulane University is now occupying its new buildings in a suburb of New Orleans, in which everything has been carefully planned with a view to its adaptability to the uses of the higher engineering courses taught there. The buildings include the Sciences Building, the Physical Laboratory, the Chemical Laboratory, and the large group of engineering laboratories and workshops.

In electrical engineering, the equipment is very fine, there being in all about twenty dynamos for direct and alternating incandescent and arc service. The switchboards are of marble and slate, and there is a large collection of arc lamps, converters and measuring instruments. The course in electrical engineering is under the direction of Prof. Brown Ayres, dean of the University.

PLANS have been prepared by Cyrus L. W. Eidlitz, architect, for a ten-story brick store and terra cotta factory building, to be erected by the Western Electric Company, at a cost of $1,000,000, on a plot 285.9 x 142.10, at the southeast corner of Bethune and West streets. The building will be rectangular in shape, with a court in the center, opening on West street.

POWER TRANSMISSION.

A STUDY OF A THREE-PHASE MOTOR.[1]

BY C. W. VAN LAW AND H. S. SIMPSON.

THE methods of testing, power measurement, etc., here described, are applicable to machines of any size and power, and although the motor tested was a small one the results are typical of motors of this class.

The machine tested was a three horse-power Siemens & Halske motor, designed for three-phase currents at low periodicity and at a pressure of 115 volts. It was at first attempted to obtain the power required from two direct current generators which had been fitted with collector rings for three-phase working, but it was found that these generators would not answer the purpose at all.

After some delay, another direct current generator was tried as an alternator, and found to give very fair results.

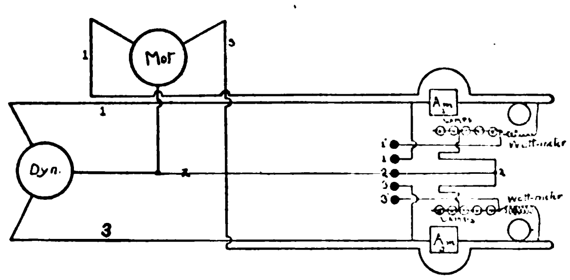


FIG. 1.

The armature was of the Gramme type, wound with large wire and few turns per coil, giving a comparatively small self-induction. To convert this machine into a three-phase alternator, the commutator was covered by an insulating sleeve of fiber, upon which were mounted three brass collector rings. These were separated by fiber rings, and were connected to three commutator segments 120 degrees apart, by set screws tapped through the fiber sleeve and into the segments. Thus, between any two rings was embraced one-third the armature coils, and three-phase current could be led off from brushes resting on the rings.

The generator was driven from a De Laval steam turbine which made 24,000 revolutions per minute. This, with 10 to 1 reduction gearing, and a bi-polar field, gave a periodicity of 40. Ordinary excitation failed entirely. On open circuit, exciting from an Edison machine, 65 volts could be obtained, but this dropped to 35 on full load. Fluctuations in the Edison voltage also caused great trouble. To avoid these difficulties the following scheme was tried. Only a part of the commutator was covered by the collecting rings, and it was determined to take direct current from the bare portion, for the fields, while taking three-phase current from the rings, thus making the machine self-exciting. This was tried, but variations in the load on the three-phase circuits so changed the "direct" voltage as to make this means unsuitable. We could get 100 volts or so for excitation when the motor was not connected, but this dropped to about 70 when load was thrown on.

This means also failing, the following was finally adopted, very satisfactory results being secured. The Edison generator was placed in series with the direct current brushes on the generator in question. This summation of potential gave 170 volts available for exciting purposes, which could be cut down to the desired amount by a rheostat and bank of lamps.

The fields were now saturated, so that fluctuations in the Edison voltage were hardly noticed. Still, the potential was much lower than was needed for the motor tests, and step-up transformers were resorted to. Only two of these could then be obtained, to transform up all three circuits. This was, nevertheless, accomplished by the following arrangement.

The two primary coils were connected in series, as were also the two secondaries. One brush of the dynamo was connected to the primary junction, and the other to the free ends. If the secondary ends be used as the three terminals of the system, three-phase current may be taken off just as from the machine, but raised in potential by the ratio of the transformer employed. Conard and Ehret transformers were used, and it was found possible, owing to their excellent regulation, to hold the motor's voltage at any point desired by slight variation in the exciting current.

[1]Abstract of Thesis, Cornell University.

The efficiency runs were first undertaken; the motor being tested at various loads up to 50 per cent. above its rated power, and at voltages from half its normal potential to somewhat above the figure for which it was designed. For these runs the following scheme of connections and arrangement of apparatus was adopted.

Three wires led from dynamo to motor, the two outside wires running to the instrument table and then back, while the third ran direct from one machine to the other; a light potential wire only being carried to the instrument table.

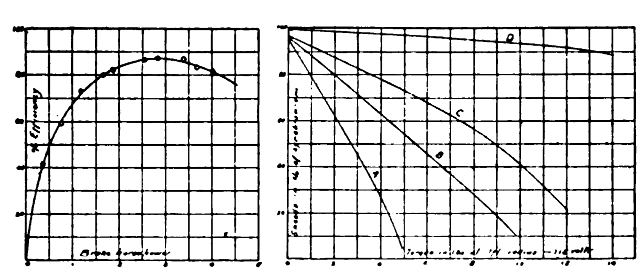
Wires 1 and 3, Fig. 1, led through two ammeters, AA, of the Westinghouse "Station" type, and thence through the current coils of two Thomson recording wattmeters to the motor. The potential coils for these meters were connected between potential wire 2, and wires 1 and 3 as shown. Both meters were designated for fifty volts only, and to protect their potential coils at the higher voltages used, strings of lamps were connected in these two circuits as indicated in the diagram. Potential wire 2 could not then be connected at such a point as to give about 50 volts across the coils of the instruments. A small switchboard was so arranged that by placing voltmeter terminals in the appropriate clips, voltages could be read across any leg of the circuit (1-2, 1-3 and 2-3) or across the potential coils (1-1' and 3-3') very quickly and easily. This switchboard is shown in points 1'-1-2-3-3' on the diagram.

Load was applied to the motor by means of a special Prony brake, having water circulation to keep it cool. The load was increased by approximately equal increments from zero to a point where the safe current capacity of the machine was reached. At each load were taken the voltmeter readings referred to above, the wattmeter speeds—time in seconds of a given number of revolutions—ammeter readings in branches 1 and 3, brake load, and simultaneous speeds of dynamo and motor. From these data, and the instrument calibrations, the efficiency, etc., at the various points could easily be obtained.

During these runs one interesting fact was noticed. It may be proven that when the angle of lag in the individual circuits is greater than 60 degrees one meter will run backward, and its readings must be subtracted from those of the other wattmeter. At 60 degrees this meter stops entirely, while as the angle becomes less than 60 degrees it starts again in a positive direction, running faster and faster as its load is increased. This was observed during the tests: One meter at light loads running backward quite rapidly. As the load was increased it slowed up, stopped and started in a positive direction, its speed now increased with the load as the other meter had done all along.

At each of the voltages at which efficiency runs were made (65, 80, 95, 110, 115 and 120) a set of torque data was also obtained. Non-inductive resistance was introduced into each of the armature circuits, and the brake load increased as before, up to the machine's capacity. At each brake load, simultaneous speeds of dynamo and motor were taken, and the results were expressed in speeds in per cent. of synchronism, and torque at one foot radius. Three different resistances were used at each voltage, of approximately 10, 5 and 2½ ohms in each circuit, and these, with the data from the efficiency runs, when the armature was short-circuited, gave four curves for each voltage.

In Fig. 2 is shown the efficiency curve taken at 115 volts, and typical for all the higher voltages. The showing made by



FIGS. 2 AND 3.—STUDY OF 3-PHASE MOTOR.

the motor is remarkably good in many respects. In the case of most small motors, the efficiency at anything but full load is very low; and the efficiency rising at once to a fairly high value, a maximum well within the capacity of the motor, and a curve nearly flat through a wide range of load, about its rated horse-power. Further, as seen from curve "D" of the torque curves taken at this same voltage, Fig. 3, the slip increases but slightly from zero to full load; being only 10 per cent. at 50 per cent. overload. The machine can be run at much above its rated capacity, right along, without danger, and is most

satisfactory in every way. The efficiency curves taken at other voltages possess much the same characteristics, that at 110 being the highest; reaching a maximum at 88 per cent., and being above 85 per cent. for quite a range of load. The efficiency at 65 volts—half the normal voltage—is still fairly high, reaching a maximum of 76 per cent., and being above 70 per cent. from less than a half horse-power up. The power, however, is much less at these lower voltages, reaching a maximum of only about 1.3 horse-power for 65 volts.

The torque curves, for 115 volts in Fig. 3 are of considerable interest as well. Curves A, B, C and D are taken with 10, 5, 2½ and 0 ohms, respectively, external resistance, approximately, in each armature circuit, for all runs. Curves "D" show only a slight slip from zero to full load, for the higher voltages, but this rapidly increases as the lower voltages are used, and at 65 volts "D" drops 10 per cent., at less than half load. The other curves are chiefly interesting as showing what starting torque might be expected with the various resistances used. By producing the curves to intersect the 0 speed line, the starting torque is evidently obtained, and is for the higher voltages, amply high for the motor to start under full load, with 2½ ohms in each circuit. A certain resistance may be found for each voltage, which will give maximum starting torque; if the resistance be either increased or diminished from this value the torque will fall off rapidly. If the armature be short circuited, as it is when running at speed, the starting torque produced is very slight; and the machine will burn up before it can be gotten to start under load. Resistance must first be cut into the armature circuits till the machine starts, and then gradually cut out as the motor speeds up, the armature being fully short circuited.

SCOTT'S SYSTEM OF POWER TRANSMISSION.

A SYSTEM of power transmission has recently been patented by Mr. Gordon J. Scott, of Philadelphia, by means of which a single-phase alternating current is broken up so as to produce a rotary magnetic field in a motor connected to the system. The single-phase alternating current is led, by means of this invention, through any desired number of circuits consecutively, and without commutation.

Fig. 1 shows the arrangement of the apparatus and circuits in this method of distribution. A represents a single-phase alternating current motor; B, an induction director, and C, the motor. The induction director, B, which is the principal feature of the system, is shown diagrammatically in Fig. 1, and in detail in Figs. 2 and 3.

The single-phase circuit A is connected to the induction director and the latter is connected with the motor by the motor circuits, b, b′, b². In this illustration b, b′, b² are field circuits,

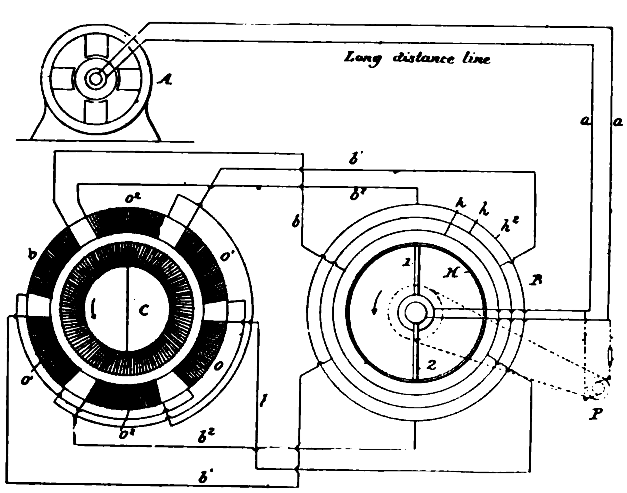
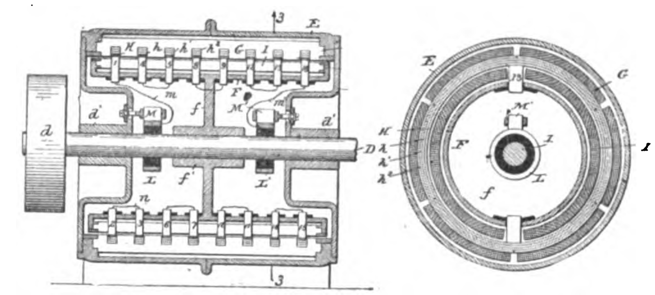


Fig. 1.—Scott's System of Alternate Current Power Transmission.

but it will be evident that they may be either field or armature circuits.

Within the frame E is a revolving cylinder, F. Surrounding the cylinder is fixed the circular laminated core, G, composed of plates which are supported in the ends of the drum. In the inner faces of the plates G are notches in which are embedded a series of copper coils or rings, the inner rings H being continuous, or closed, while the outer rings h h′ h² are continuous when solid, and made in two sections when composed of coils of wire.

On the periphery of the cylinder F is a circular series of iron plates, forming a core, I, which is arranged close to the stationary core, G, of the drum. At diametrically opposite sides of the cylinder are longitudinal rows of brushes, which are arranged opposite to, and constantly in, direct contact with, the closed or primary rings H. These rows of brushes are indicated by the numbers 1 4 5, and 2 3 6, etc., respectively, the reference figures upon the brushes indicating the order in which the current passes through them. Upon the shaft D are insulated rings, L and L′, and in contact



Figs. 2 and 3.

with these rings are stationary brushes, M M′, to which are connected the terminals of the alternating circuit a.

The internal circuits of the induction director are as follows: The current entering through the brush M passes to ring L and thence through wire m to the brush 1, where it divides and passes in opposite directions around the ring H to the brush 2, (see Fig. 2), thence through wire n to the brush 3, and then around second ring H in opposite directions to brush 4. Similarly the brushes in each of the rows are connected in pairs, and the current passes in opposite directions around each pair of adjacent rings until it reaches the last brush, which, in the illustration, is numbered 16. In other words, the rings H are connected in series. From brush 16 the current passes to the ring L′ and back to the line through brush M′.

It will be seen that the direction of the currents being opposite in adjacent rings H will set up alternate north and south poles throughout the laminated cores G. The movable core I is arranged close to the stationary core G in order to complete the magnetic circuits around the rings. The sets of secondary rings h h′ h², respectively, may be connected together in series or in multiple, and the motor circuits are connected to the terminals of the sets.

For turning the shaft of the induction director several methods are possible. An independent motor, P, is adopted for this in the illustration, Fig. 1.

The operation of the induction director above described is as follows: The current passing in opposite directions through the rings H will set up strong induced currents in the secondary rings. The points of greatest difference of potential in the secondary rings will always be opposite the brushes, and the points of least difference of potential will be at right angles to the brushes, while diametrically opposite points in other parts of the rings will have a difference of potential varying with their proximity to the line of the brushes. It will thus be understood that with the brushes and connections, as shown in Fig. 1 the coils o² in the motor circuit b² will be strongly energized, while the coils o and o′ in the circuits b and b′ will be less active, all of the coils tending to set up poles of opposite polarity at points midway between the coils o² The rotation of the brushes, it will be readily seen, will rotate the points of maximum and minimum potential in the secondary rings, and the motor circuits will be energized in rotation and a rotary field be set up in the motor. It will, therefore, be seen that in order to regulate the speed and direction of the revolving part of the motor it is simply necessary to regulate the speed and direction of the induction director, as the motor will run synchronously with it.

The currents set up in the motor circuits gradually rise from zero to a maximum and then gradually fall, and may be aptly called the waves of current and electromotive force. This wave action of the induction director is a feature which distinguishes it from machines having similar functions, and in which the current is shifted from one circuit to another by means of commutators, switches, or other make-and-break devices.

BERLIN, GERMANY.—Messrs. Siemens & Halske, of Berlin, have recently secured a contract for an electric drilling plant for the State salt mines at Hallein. The plant will comprise a high-pressure turbine coupled direct to a continuous-current dynamo and two boring machines.

Telephony and Telegraphy.

INDUCTANCE AS A NEGATIVE CAPACITY IN SUBMARINE CABLES.

BY A. DAVIDSON.

THE following experiments, to exhibit the value of inductance as a negative capacity, were made on a length of submarine cable of modern type, armored with steel wires and coiled in an iron tank. This piece of cable gave a circuit possessing inductance, capacity and resistance. By a suitable arrangement, either capacity or inductance could be made to predominate. It is hoped that the experiments will be of interest, on account of the commercial value of a "distortionless" cable.

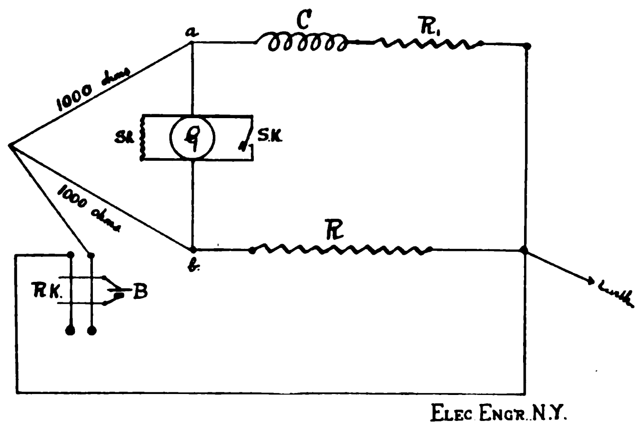


FIG. 1.—R.K., REVERSING KEY; B., BATTERY (20 CELLS LECL.); G., GALVANOMETER, 30,000 OHMS. THOMSON; Sh., GALVANOMETER SHUNT, $\frac{1}{1000}$TH THROUGHOUT EXPERIMENTS; S.K., SHORT-CIRCUITING KEY; R., RESISTANCE BOX; C., 54 N. MILES CABLE. C.R. = 157 OHMS. CAP. = 18.9 MFS.; R., ADJUSTABLE NON-INDUCTIVE RESISTANCE.

The arrangement used is shown in Fig. 1. The cable was inserted in one arm of a Wheatstone bridge, together with an adjustable resistance, R_1. It was then balanced for steady C_1R_1 with $R_1 = 0$. The galvanometer short-circuit key was then left open and the swing, on depressing the battery key, observed. R_1 was then increased, a steady balance again taken and the new movement noted. Table 1 gives the value obtained.

When inductance prevails in the cable circuit the potential at a lags behind that at b. The result is a swing on the galvanometer. Owing to the great inductance of the coiled cable quite

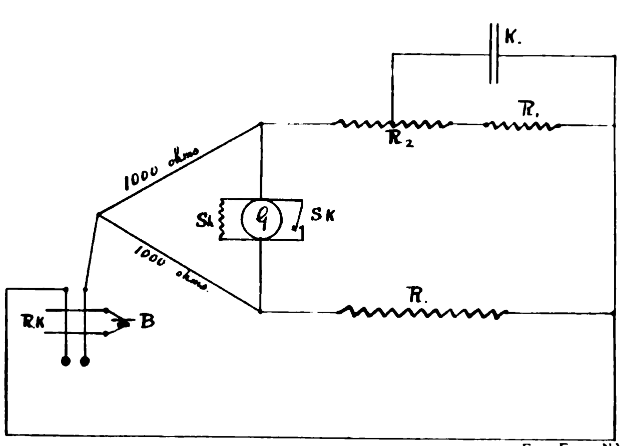


FIG. 2.—R_2, NON-INDUCTIVE RESISTANCE EQUAL TO C.R. OF CABLE; K., 20 MFS. CONNECTED TO THE MIDDLE OF R_2. The other parts are the same as in Fig. 1.

an appreciable time elapses before the potential at a equals the potential at b, and the spot drifts back very sluggishly to zero. When capacity prevails, the potential at a leads the potential at b, giving a swing in the opposite direction to that observed when inductance prevails. This swing is quite sharp. At certain times, (R_1 = fom 700 to 1,300 ohms), it could be observed riding over the inductance swing; first, a sharp swing to the right, followed by a slower swing to the left, then a drift to zero. Both swings are given in Table 1. This overlapping was the principal difficulty met with in taking these observations. It was, of course, essential to use an

TABLE I.

R_1.	Swing.	
0		680 divisions left.
100		450 " "
200		340 " "
300		260 " "
400		210 " "
500		170 " "
600		145 " "
700	8 divisions right then	125 " "
800	10 " " "	120 " "
900	15 " " "	100 " "
1000	20 " " "	90 " "
1100	23 " " "	80 " "
1200	25 " " "	78 " "
1300	25 " " "	
1400	30 " " "	
1500	31 " " "	
1600	35 " " "	
1700	38 " " "	
1800	40 " " "	
1900	44 " " "	
2000	47 " " "	
9000	92 " " "	
50000	110 " " "	

"earth," as shown in Fig. 1, in order to bring the full capacity into play. When "earth" is not used the capacity effect did not become apparent, even when R_1 was very large.

To separate the inductance from the capacity effect the "earth" connection was thrown off and a series of readings taken. These are entered under "Inductance Swing" in Table 2. Experiment showed that with R_1 = 50,000 ohms, the capacity between the legs of the cable loop was not in evidence. These readings may, therefore, be taken as due to inductance.

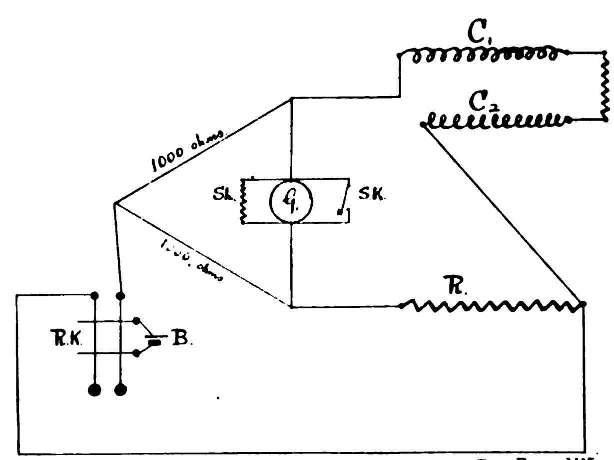


FIG. 3.—C_1 = 65 N. MILES OF CABLE. C.R. = 600 OHMS; CAP. = 22 MFS.; C_2 = 54 N. MILES OF CABLE. C.R. = 140 OHMS; CAP. = 18.9 MFS.; R_1 = ADJUSTABLE NON-INDUCTIVE RESISTANCE. Other parts as in Fig. 1.

An artificial circuit was then made up, as shown in Fig. 2, with resistance and capacity only, to represent the cable. The capacity was lumped at the center of the circuit for convenience, but the error due to this is probably slight. The readings

TABLE II.

R_1.	Inductance Swing.	Capacity Swing.
0.	680 divisions left.	2 divisions right.
100	450 " "	10 " "
200	330 " "	15 " "
300	265 " "	21 " "
400	200 " "	26 " "
500	175 " "	32 " "
600	145 " "	37 " "
700	125 " "	41 " "
800	105 " "	44 " "
900	92 " "	47 " "
1000	81 " "	50 " "
1100		54 " "
1200		56 " "
1300		58 " "
1400		60 " "
1500	50 " "	62 " "

with this arrangement are tabulated in Table 2, under "Capacity Swing." Comparison with Table 1 shows that with R_1 = about 1,300 ohms, the inductance and capacity swings are approximately equal, but opposite in both experiments.

To bring the capacity between the legs of a metallic loop into evidence, the arrangement shown in Fig. 3 was used. Two lengths of cable were used and R_1 inserted between them. Unfortunately, the lengths were of different types, so that the loop was not a symmetrical one electrically. Still the results, shown in Table 3, are interesting, as displaying a method which may possibly be useful in determining the effective capacity of a metallic loop, an important quantity in telephone engineering.

TABLE III.

R_1.	Swing.
0.	185 divisions left.
100.	160 " "
200	135 " "
300	120 " "
400	105 " "
500	95 " "
600	85 " "
700	77 " "
800	70 " "
900	65 " "
1000	60 " "
3000	25 " right.
4000	32 " "
5000	37 " "

These experiments can only claim to be of a qualitative value. As such, they show that inductance does tend to nullify a distributed capacity, though not completely, owing to the enormous difference between the electromagnetic and the electrostatic time constants of the circuit. As an old truth in a novel form, I think they are worthy of publication.

NEW MOVES IN THE TELEPHONE FIELD.

THE POSTAL-TELEGRAPH-CABLE COMPANY has recently arranged to extend its business into Southern territory, where at present it has no lines whatever. A new company called the Postal Telegraph-Cable Company of Texas has been organized and arrangements have been entered into with the parent company in New York for the transaction of this business. The fact that the directorate of this Texas company contains the names of a number of men who are heavily interested in the Erie Telephone Company, one of the largest of the subsidiary Bell telephone companies, gives rise to the suggestion that the Postal company is about to enter the telephone field, a step that might greatly annoy its great rival, the Western Union Company. It is further reported from Texas that the Postal will use the wires of the Erie Telephone Company to cover Arkansas and Texas. This, however, is denied by officers of the company.

President A. B. Chandler, of the Postal company, said recently:

"This company is not in the telephone line. It seeks only commercial telegraph business. In order to reach the Southwest it was deemed advisable to form the separate Texas company, principally from among men interested in the Postal company. There is no alliance with the Erie Telephone Company, and we have made no arrangements to use its wires. I can see that the fact of Erie men being in the Texas company would naturally give rise to reports of an alliance, but such is not the case. The telephone men went into the corporation simply as an investment. It is a common thing for men of wealth to be interested in several companies. The Postal company is not going into the telephone business. We are not restricted or bound by telephone agreements of any kind."

In regard to the telephone situation in New York, there is still much reticence concerning the new $16,000,000 New York Telephone Company, which takes the place of the Metropolitan Telephone and Telegraph Company. The officials of these companies have not yet published any statement regarding it. This company will still be subsidiary to the American Bell Telephone Company, which is the parent corporation of most of the operating companies throughout the country. It is generally believed now that the New York company was formed for the purpose of combining more compactly existing companies in the East, and the secrecy is due to delay in perfecting details.

It is probable that the Philadelphia and Pennsylvania telephone business will be affected by this new company, as $9,000,000 of its capital is available for the purchase, lease or control of companies outside of New York. Many companies in Pennsylvania operate under licenses from the Bell company, and most of them have been controlled by local capital, but it is now said that the leading spirits of the Western Union and some of the stockholders of the American Bell Telephone Company have been quietly buying stocks until the most important of the local companies are prepared to go into the deal. The new company is believed to be behind a large number of new local telephone companies lately organized in various places, which have been brought into life for the purpose of forcing into the deal the Bell companies that are adverse to either selling or leasing.

THE NEW YORK TELEPHONE CO.

The above company have issued notices to their subscribers that they have assumed the business of the Metropolitan Telephone and Telegraph Company.

Regarding a new method of overtime charge on Long-Distance messages, the following notice has been issued:

On and after July 1 the charge for overtime, beyond the initial period of five minutes, will be made by the minute, at the rate of one-fifth of a single message for each additional minute. We shall discontinue the practice of notifying the subscriber at the end of each five minutes how much time has elapsed. To suburban points, including Monmouth County and Lakewood, N. J., there will be no change from present method of charging excess time, i. e., for five minutes, or fraction thereof, one message; from five to ten minutes, two messages, etc.

NEWS AND NOTES.

THE ELECTRIC FURNACE.

Professor Dewar, in a lecture at the Royal Institution, in discussing the posibilities of synthetical chemistry which have been disclosed by the electric furnace, stated that from the carbides prepared in the electric furnace we can get benzine, and, therefore, all the aniline dyes, and even crude petroleum. Acetylene gas, another product of the electric furnace, combines directly with nitrogen in the presence of an electric discharge and gives prussic acid, and from this we can readily get cyanides. In fact, there is no end to the sphere of usefulness of the electric furnace.

ELECTRICAL SEPARATION OF TELLURIUM FROM COPPER RESIDUES.

A method for the separation of tellurium from copper residues is described by Mr. Cabell Whitehead in the "Journal" of the American Chemical Society. In the electrical refining of copper the washings from the gold residues contain the tellurium as tellurous oxide or sulphate. The tellurium may be obtained from these either by precipitation with copper or by passing sulphurous anhydride through the solution. It may be finally purified by distillation in hydrogen. When a solution of sodium tellurite is added to a solution of an ammonium salt, a white precipitate of tellurous anhydride is thrown down, which becomes granular on boiling. A small amount of tellurium or of some metal which can be precipitated by sulphurous anhydride remains in solution; this soluble portion is still under investigation. Potassium ferrocyanide does not react with tellurium chloride at once, but after a few hours prussian blue is formed. When tellurium is heated with aluminum the two combine with explosive violence, forming a chocolate colored compound difficultly fusible, which has the composition of $Al_2 Te_3$. It is hard and brittle, and can readily be ground to powder; when exposed to moist air it is decomposed and hydrogen telluride is slowly evolved; when thrown into water it is rapidly decomposed. Tellurium is readily deposited by an electric current either from an acid or alkaline solution. It has been found possible to separate tellurium from copper by adding an excess of sodium hydroxide and about 3 grammes of potassium cyanide for each gramme of copper present, and passing an electric current through the solution, when the tellurium is thrown down as a black, nonadherent precipitate, which can readily be filtered off; the solution can then be slightly acidified with sulphuric acid, and the copper estimated in the usual way by electrolysis.

A HIGH-PRESSURE CURRENT AND FIRE STREAMS.

An experiment to ascertain whether a high-pressure alternating current can be sent from a conductor to earth by means of a jet of water from a hose of a fire engine, and also whether the current can be transmitted to the fireman under such circumstances, was made a short time ago by Professor Slaby, of Berlin. The overhead conductors of a 10,000 volt power transmission line were used for the experiment. A voltmeter was connected between the metal mouthpiece of the water hose and the earth. On turning the water on to the live conductors no flow of current to earth was noticeable.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 30, 1896.

Alarms and Signals:—

ELECTRIC SIGNAL. C. H. Sherwood, Utica, N. Y., 562,929. Filed Oct. 21, 1895.
Consists of bell located at street crossing and means for closing and breaking circuit by passing trains.

AUTOMATIC ALARM FOR POSTAL CHUTES. T. F. Hagerty, Woburn, Mass., 563,033. Filed Jan. 21, 1896.
An electric contact within the chute adapted to be operated by falling letters.

FIRE ALARM. J. R. McCoy, Marshalltown, Ia., 563,203. Filed July 10, 1895.
The combination with alarm mechanism and leads under tension connected with the alarm mechanism, of fusible couplings arranged at intervals in the leads.

Batteries, Galvanic:—

GALVANIC BATTERY. E. S. Boynton, Brooklyn, N. Y., 563,127. Filed Feb. 21, 1895.
The elements while independently removable have one common electrolyte.

Conductors, Conduits, and Insulators:—

CONDUIT FOR ELECTRICAL CONDUCTORS. J. F. Cummings, Detroit, Mich., 562,806. Filed March 4, 1895.
Consists in an outer metallic pipe and an inner lining of wood or similar material, made in sections arranged in tubular form, and forced into the outer pipe, which acts to hold the lining in shape.

MEANS FOR PROTECTING UNDERGROUND ELECTRICAL CONDUCTORS. F. Davis and R. E. B. Crompton, London, England, 562,808. Filed April 11, 1893.
Cellular cases divided longitudinally into polygonal passages.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. G. J. Scott, Philadelphia, Pa., 562,924. Filed Jan. 3, 1896.
See page 43.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. N. W. Storer, Wilkinsburg, Pa., 562,864. Filed Oct. 2, 1895.
The extreme edges of the field magnet pole pieces are provided with slots extending transversely to the armature axis.

DYNAMO ELECTRIC MACHINE. C. C. and H. B. Warren, Chicago, Ill., 562,868. Filed Jan. 31, 1896.
Comprises a field core in the form of a hollow ring, armature coils disposed upon said core with a magnetizing coil secured within the interior of said ring, and a shelf projecting from the interior wall of said hollow ring, adapted to support said magnetizing coil.

Electro-Metallurgy:—

APPARATUS FOR CIRCULATING LIQUIDS IN TANKS. O. Szontagh and A. F. Schneider, Perth Amboy, N. Y., 563,093. Filed March 12, 1896.
Adapted for use in tanks for the electrolytic deposition of copper and other metals.

PROCESS OF EXTRACTING COPPER FROM ORES. J. Douglas, New York, 563,144. Filed Jan. 8, 1896.
Consists in suspending solid cuprous chloride in an electrolyte, inserting the cathode into the said solid cuprous chloride, and the anode into the electrolyte, and passing a current therethrough.

PROCESS OF EXTRACTING COPPER FROM ORES. J. Douglas, New York, 563,143. Filed April 11, 1895.
Consists in moistening solid cuprous chloride with water, inserting both electrodes of an electric circuit in the said solid cuprous chloride, and then passing an electric current therethrough.

Lamps and Appurtenances:—

HANGER FOR LAMPS. Erastus F. Hershaw, Abingdon, Ill., 563,232.
Comprises a pulley, and counterweight, the lamp being secured to the end of the wire.

Miscellaneous:—

ELECTRIC GAS LIGHTING APPARATUS. F. O. Plummer, Worcester, Mass., 562,850. Filed Aug. 16, 1895.
Adapted for incandescent gas burners.

ELECTRIC HAND LIGHTING GAS BURNER. G. J. Galbraith, Boston, Mass., 562,891. Filed April 18, 1896.
Details of construction.

THERMOSTAT. C. B. Rogers, Stevenson, Md., 562,917. Filed April 1, 1896.
Details of construction.

ELECTRIC HAND LIGHTING GAS BURNER. H. C. Thomson, Boston, Mass., 562,937. Filed April 18, 1896.
Consists in devices for operating the movable electrode simultaneously with the gas valve.

ELECTRODE FOR GALVANIC BELTS. E. S. Collicott, London, England, 563,016. Filed May 18, 1896.
Embodies two or more reticulated plates of aluminum or other metal which does not injuriously affect the skin, the said plates being connected by wires to the two poles of a pocket electric battery.

ELECTRIC HEATER. W. S. Hadaway, Jr., New York, 563,032. Filed Feb. 27, 1896.
The combination of a heat-radiating surface, and an electrical conductor in the form of a graduated helix disposed in spiral form, upon said radiating surface, but insulated therefrom.

AMALGAMATOR. F. B. Austin, Tempe, A. T., 563,119. Filed June 4, 1895.
The combination with a sluice having an opening therein, of a pan arranged in said opening and having inwardly extending and horizontal flanges at its sides, a cover plate resting on said flanges, the plate being insulated from the pan, spikes respectively projecting from the plate and pan, and means for electrically charging said plate and pan.

DOUBLE ACTING THERMOSTAT. H. Cortland, Toledo, O., 563,138. Filed June 3, 1895.
Comprises a frame, a convex flexible diaphragm secured therein, conducting fingers secured to the frame and insulated therefrom and operated by the diaphragm, the opposite ends of the fingers extending over the opposite side of the frame, and a contact screw secured directly in the frame beneath the ends of the fingers.

ELECTRIC PROGRAM-CLOCK. Dora Ogden, Columbus, Ind., 563,052. Filed Oct. 12, 1895.
Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY. H. Brandenburg, Chicago, Ill., 562,796. Filed March 11, 1895.
A shallow conduit adapted to rest upon the cross-ties of any railroad, having portable covers of angle irons, forming a continuous slot on the top, and conveying the electric conductors therein.

ELECTRIC RAILWAY. B. Ford, Johnstown, Pa., 562,890. Filed Aug. 30, 1896.
A sectional conduit system employing a battery on the car for operating the circuit controlling devices.

ELECTRIC RAILWAY. W. E. Hanshue, Kalamazoo, Mich., 562,894. Filed Feb. 27, 1894.
Comprises a double tubular casing with an opening at the top; suitable insulating lining for said casing; and copper bars supported on said insulation to transmit the electric current to the motor in the car and return it from the car.

TROLLEY WHEEL. I. B. Metzger, Canton, O., 562,904. Filed June 20, 1894.
A hollow wheel in which is placed an oil reservoir and means for feeding oil to the wheel spindle.

AUTOMATIC SPEED CONTROLLER FOR ELECTRIC CARS. H. A. Seymour, Washington, D. C., 562,925. Filed May 10, 1896.
The combination with an electric motor and its casing, of a speed governor and set of resistances mounted in or upon said motor casing, and brake mechanism having its brake magnet in circuit with said resistances.

TROLLEY. C. E. Powell, Bryn Mawr, Pa., 562,972. Filed Sept. 19, 1895.
Comprises a frame attached to the top of the car and carrying a trolley wheel, said frame being hinged to the top of the car.

ELECTRIC RAILWAY. J. Tatham, Philadelphia, Pa., 563,094. Filed Sept. 1, 1891.
Comprises a slotted conduit, a conductor therein, an insulating lining within the conduit and insulating blocks for supporting the conductor therein, said blocks having inclined approaches for lifting the current collector.

ELECTRIC RAILWAY TROLLEY SYSTEM. W. C. Keithly, San Francisco, Cal., 563,244. Filed Oct. 22, 1895.
Underground trolley.

Switches, Cut-Outs etc.:—

CUT-OUT FOR ELECTRIC CIRCUITS. G. W. Scovil and E. F. Gooding, Elgin, Ill., 562,980. Filed Aug. 27, 1895.
Details of construction.

Telegraphs:—

TELEGRAPH ALPHABET. S. V. Essick, Yonkers, N. Y., 563,148. Filed Sept. 16, 1895.
The characters are distinguished by the distance between two indicating points.

TELEGRAPHY. S. V. Essick, Yonkers, N. Y., 563,149. Filed Sept. 27, 1895.
Consists in means for causing impulses successively alternating in polarity in the line, each alternation of which represents a complete letter, combined with a receiver controlled by such successive impulses and adapted to record a letter for each alternate impulse.

Telephones:—

TELEPHONE ATTACHMENT. Will W. Dale, Fostoria, O., 562,807. Filed July 10, 1895.
Coin controlled apparatus.

SIGNALING APPARATUS FOR TELEPHONE LINES. F. R. McBerty, Downer's Grove, Ill., 562,906. Filed Oct. 29, 1895.
Provides a subsidiary path controlled by the current to the substation, for permitting the normal signal exciting current to flow.

ELECTRIC SIGNALING APPARATUS. M. Du Perow, Washington, D. C., 563,025. Filed Aug. 3, 1895.
Consists in the use of an electric motor, actuated by the local battery of a telephone and automatically set in motion by the switch hook, for operating the electric generator.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 563,073. Filed June 12, 1895.
A system of signals adapted to indicate continuously the condition of each telephone line.

TELEPHONE SYSTEM. J. G. Smith, New York, 563,084. Filed Aug. 6, 1894.
Details of an individual call system.

TELEPHONE SWITCHBOARD SYSTEM. C. E. Scribner, Chicago, Ill., 563,245. Filed Nov. 4, 1895.
Consists in the combination, with the telephone line, of a relay controlling the connection of the line with the central source of current, and means for exciting the relay during the use of the line in conversation.

ARCTIC THUNDERSTORMS.

At the last meeting of the Royal Meteorological Society for the present session, Mr. H. Harries read a paper on "Arctic Hail and Thunderstorms," in which he showed that the commonly accepted opinion that hail and thunderstorms are almost, if not quite, unknown in the Arctic regions is incorrect. He had examined 100 logs of vessels which have visited the Arctic regions, and found that out of that number no fewer than 73 showed that hail was experienced at some time or other. Thunderstorms were not so frequent as hail, but they have been observed in seven months out of the twelve, the month of greatest frequency being August. Mr. Harries is of opinion that the breeding place of thunderstorms in these high latitudes is in the neighborhood of Barent's Sea.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

CHRISTY FIRE CLAY COMPANY.

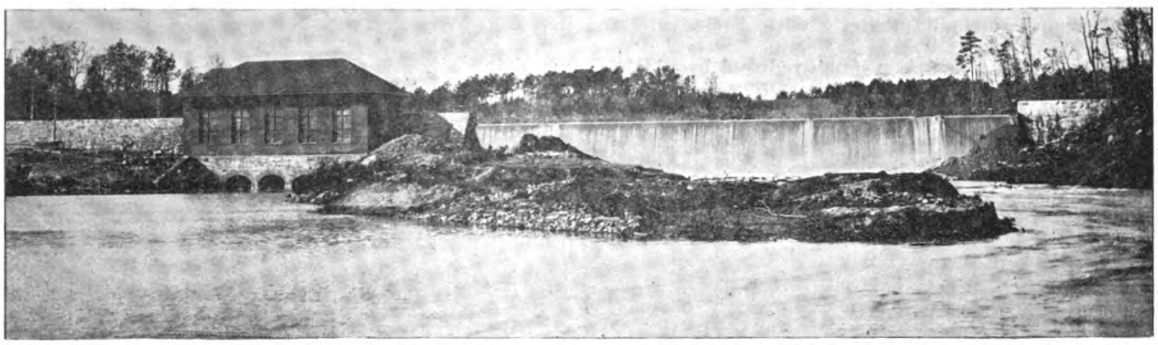
We are in receipt of a souvenir paper weight from the Christy Fire Clay Company, corner of Fourth and Olive streets, Chicago. The paper weight is a sample of one of the products of this company and its material will resist the action of high temperatures up to 3,800 degrees F., as determined by tests made on Seger cones by Prof. H. O. Hoffman, of the Massachusetts Institute of Technology, Boston, Mass.

The importance of suitable material for fire clay is now fully realized in numerous lines of manufacture and the preparation and manufacture of high grade refractory material for glass works, smelters, iron and steel founders, steam plants, etc., requires exhaustive and continuous theoretical and practical investigation.

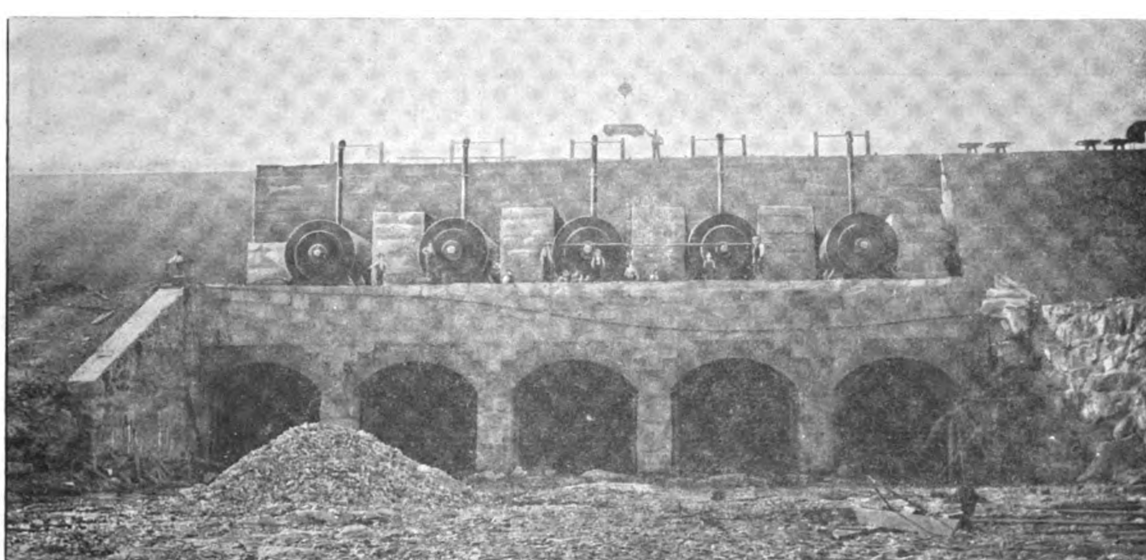
The company makes a specialty of manufacturing tank furnace blocks and pot furnace stone, fire clays raw, burnt and ground for all purposes.

THE PELZER (S. C.) MFG. CO.'S POWER PLANT.

The accompanying engravings illustrate the power plant recently installed for the Pelzer Manufacturing Company, Pelzer, S.C. One engraving shows the dam and power house, the other view showing five pairs of 39-inch horizontal Victor turbines in position, each pair of which is coupled direct to a 1,000 horse-power generator and regulated by a Giessler electro-mechanical governor. The power thus generated is transmitted electrically to the cotton mills of the corporation about three and one-half miles distant. This is putting 5,000 horse-power into a very narrow space and the arrangement permits locating the factories at a most eligible site. The dam and power house were built by W. A. Chapman & Co., Providence, R. I. The electrical machinery was furnished by the General Electric Company, of New York, and the turbines, feeders, power connections and electro-mechanical governors, together with all the plans for the entire development were furnishd by the Stilwell-Bierce & Smith-Valle Company, Dayton, O.



POWER HOUSE AND DAM, PELZER MFG. CO., PELZER, S. C.



VIEW OF TURBINES, PELZER, S. C., ELECTRIC POWER TRANSMISSION PLANT.

ENLARGEMENT OF THE PITTSBURG REDUCTION CO.'S PLANT AT NIAGARA.

In the enlargement of the electric plant of the Pittsburg Reduction Company, at Niagara Falls, the General Electric Company are placing rotary converters, which are the largest machines of their kind ever built. They will be five in number, each designed to deliver 600 kilowatts in direct current at a voltage of 160. They have sixteen poles and are operated at a speed of 188 revolutions per minute. Their commutators are of very large size, 3,750 amperes being delivered from each with carbon brushes.

The General Electric Company have adopted a novel method of construction in these machines by which the commutator is very effectively kept cool by ventilation. Air is drawn through the commutator spider, and, after passing over an extended surface inside the commutator, it passes out between the laminations of the armature and around the leads from the windings to the commutator.

In connection with each of the machines two 300 kilowatt transformers are used. The rotary converters are operated in pairs, each pair supplying one of the Pittsburg Reduction Company's circuits. So far two of these pairs, also one spare machine, have been installed, and there is still room for another pair in the apartment assigned to them. When the full equipment has been installed, the capacity of the electrical plant will be 4,500 horse-power, not counting in this the spare 750 horse-power unit. In the electrical plant of the Pittsburg Reduction

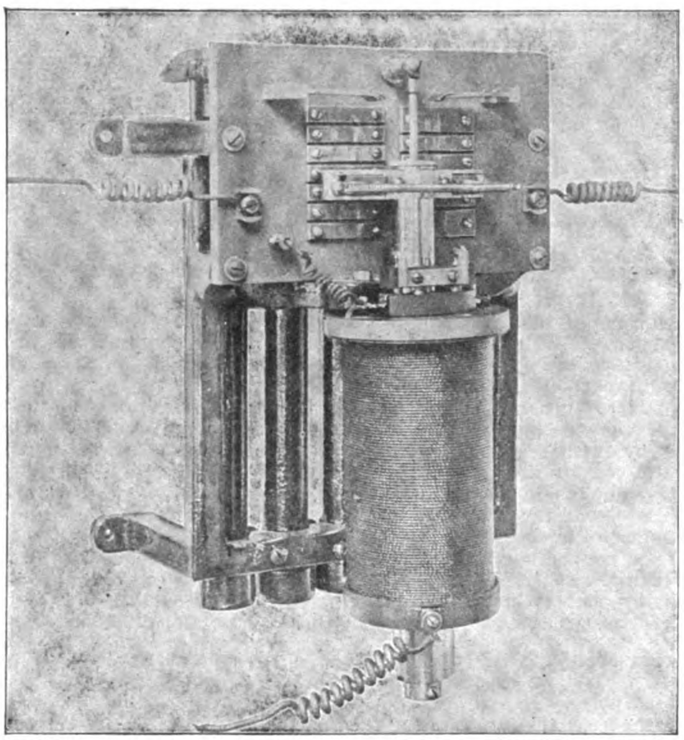
Company, the transformers are built on iron floor plates over a trench having brick retaining walls. In this trench air pressure is maintained by a small blower, and the air from the trench passes upward through the transformers and in its passage carries off the heat generated in them. All the conductors used, except the heavy current bus-bars, are placed below the floor, many being in the trench below the transformers.

The new plant of this company, now being erected on the property of the Niagara Falls Hydraulic Power and Canal Company, will be in operation before long.

A NEW SOLENOID AUTOMATIC MOTOR STARTER.

THE accompanying illustration shows the latest development of this form of automatic motor starter, brought out by the Automatic Switch Company of Baltimore, Md., which combines the remodeled working parts of their well known "Whittingham solenoid starter" with their tubular fireproof resistance.

The size of the apparatus has been much reduced by placing the dash pot and plunger inside of the solenoid, and the direction of movement allows the use of compression, instead of suction control.



THE SOLENOID AUTOMATIC MOTOR SWITCH.

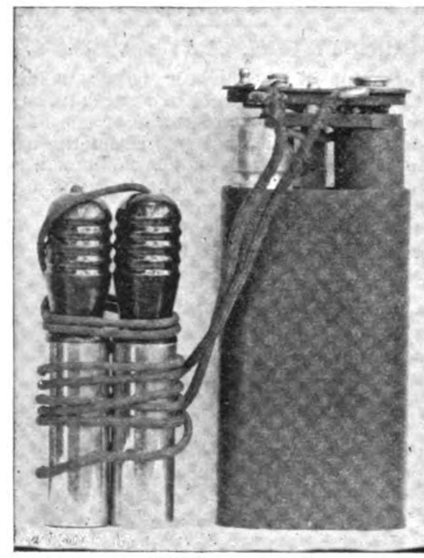
Renewable carbon brushes engage heavy copper contacts while carrying the starting current, and a substantial metallic circuit is closed when all the resistance is cut out.

This apparatus is particularly adapted for service wherever it is desired to start a motor automatically from a distance, such as elevator, pumping, and similar installations.

A POCKET FARADIC BATTERY.

THE CAPO-FARAD BATTERY AND APPLIANCE WORKS, of 27 Thames street, New York City, are putting upon the market a very efficient and compact pocket Faradic battery, which we illustrate herewith. The use of Faradic currents in certain cases of nervous and other affections is now a recognized necessity and has resulted in developing a large variety of apparatus for this purpose. It is necessary in such cases to employ a battery capable of yielding considerable current, and if good results are desired it must also be free from polarization.

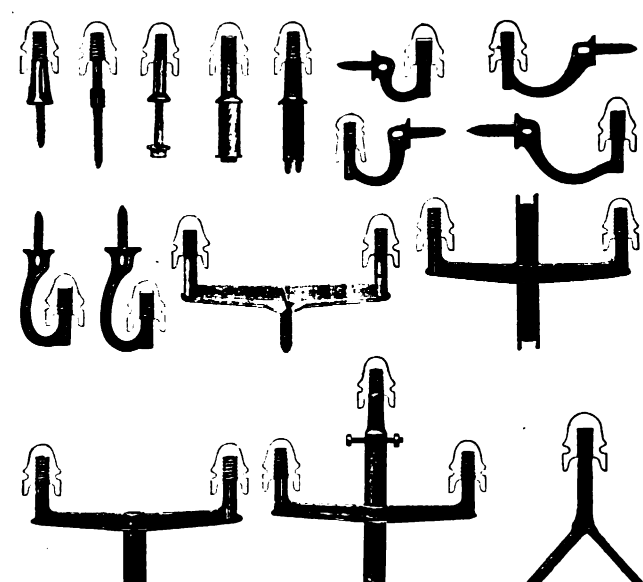
The apparatus consists of a single cell of the well-known Capo-Farad battery in conjunction with a Faradic coil of approximately the same length, both being inclosed in a vulcanite case. A switch is provided and the strength of the current is perfectly controlled by means of a sliding tube which forms a closed secondary around the iron core. The apparatus measures 2 by 3¾ by 1 inch, weighs 6 ounces and may be readily carried in the vest-pocket.



THE CAPO-FARAD MEDICAL BATTERY.

L. S. BEARDSLEY'S SPECIALTIES.

WE illustrate herewith a number of the line fixtures and other metal devices manufactured by L. S. Beardsley, of Naugatuck, Conn. Among these will be seen screw pins and bolt pins of various designs, window and cornice hooks of different patterns designed for use with different thicknesses of glass; break-arms to use either under or over cross-arms; and branch-arms to be inserted either from the top or bottom of the cross-arms. The general design and arrangements of these articles will be readily seen by reference to the accompanying illustrations.



BEARDSLEY'S MALLEABLE IRON PINS AND BRACKETS.

THE CARBON ELECTRIC GENERATOR COMPANY has been formed at Portland, Me., with a capital stock of $5,000,000, $800 paid in. The officers are W. H. Forbes, president, and W. C. Forbes, treasurer, both of Milton, Mass.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. JULY 15, 1896. No. 428

Electric Lighting.

THE ELECTRIC LIGHTING OF THE METROPOLITAN LIFE INSURANCE COMPANY'S BUILDING, NEW YORK.

It is not so very long ago that a private plant of a few hundred lights was considered a large installation and well worthy of extended notice in the technical press; but at the present time such installations have barely a paragraph devoted to them, overshadowed as they are by those in the large modern skyscrapers with thousands of lamps. A striking example of this kind, not only on account of the magnitude of the installation, but also on account of the methods employed in carrying out the work, is the electric lighting plant in the new Metropolitan Life Insurance Company's Building, facing Madison Square, New York, where its white marble front makes it the most prominent architectural feature of the Square.

ENGINES AND DYNAMOS.

Beginning with the heart of the plant, the engine and dynamo room, which part of the equipment is located on the Twenty-third street side of the building, running out under the sidewalk to the curb line, it may be premised that the new plant which we are about to describe is an extension of the one originally installed, which was found to be inadequate when the new eleven story annex on Twenty-fourth street was erected. We find as a remnant of the original plant two Corliss engines, driving by means of belts two 100 kilowatt 110 volt dynamos, revolving at 270 revolutions per minute, shown in our engraving Fig. 1; and in addition to these machines there are two 100 kilowatt generators, direct coupled to Armington & Sims engines, running at 230 revolutions per minute. One of these units is shown in Fig. 2.

All of these machines are compound wound, with iron clad ventilated armatures. They all have six poles, and are provided with carbon brushes, all of which can be raised simultaneously by means of a single lever. In order to avoid the resistance due to loose contacts, all the brushes are in direct connection with the brushholder by means of flexible copper strips. In order to provide for thorough ventilation, the armature core is built up in sections of one inch of core and 1-16 of an inch of air space alternately. The air is drawn in at the sides between the commutator segments, and thrown out by centrifugal action at the periphery, thus keeping up a continual circulation. The result is that the machines can carry an overload of 40 per cent. for one hour, and the regulation is such that no movement of the brushes is required between zero and full load. The belt-driven machines have outboard bearings on the pulley side, so that the bearing is relieved of all strain.

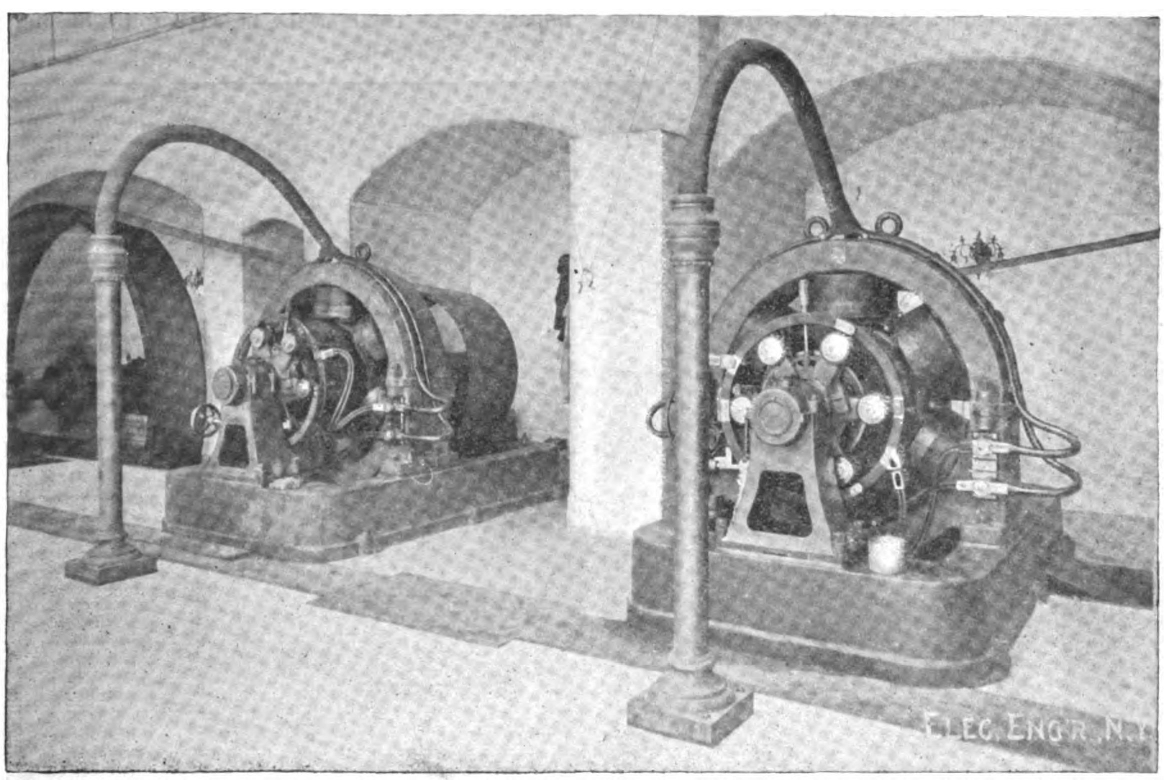


Fig. 1.—View in Dynamo Room, Metropolitan Life Insurance Building, New York.

The Corliss engines mentioned above which formed part of the original plant, drove a pair of high speed bi-polar dynamos through counter shafting, but as it was found that these machines could be used for running during light loads, they have been retained in another part of the plant, and the Corliss engines utilized for direct driving, and space considerably economized by the discarding of the counter shafting.

THE SWITCHBOARD.

The switchboard controlling the entire plant is illustrated in engraving Fig. 3, which gives but a faint idea of its beauty; the board embodies every device recognized as the latest and best of its kind for switchboard work. It is arranged for six

dynamos, four being the 100 kilowatt machines in the main engine room, above described, and two 50 kilowatt bi-polar machines, which were replaced in part by the new plant.

The current is led from the machines through heavy cables, which arch gracefully into the top of and pass down ornamental

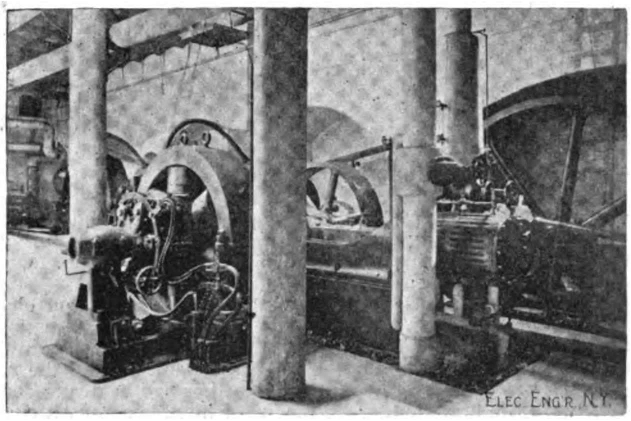


FIG. 2.—DIRECT CONNECTED UNIT, METROPOLITAN LIFE INSURANCE BUILDING.

pillars into the floor; here they enter into iron armored conduit, laid in brick-lined trenches which run to the back of the switchboard. The outlets are shown in Fig. 4, which gives a rear view of the central dynamo section of the switchboard.

As will be seen in Fig. 3, this section of the switchboard is equipped at the bottom with a row of six Harrington circuit breakers, one for each machine. Above these are the handles

meter, etc. Two ammeters are taken off the same shunt of the main bus-bar, one of these ammeters being placed on the switchboard, and the other in the boiler room to indicate the

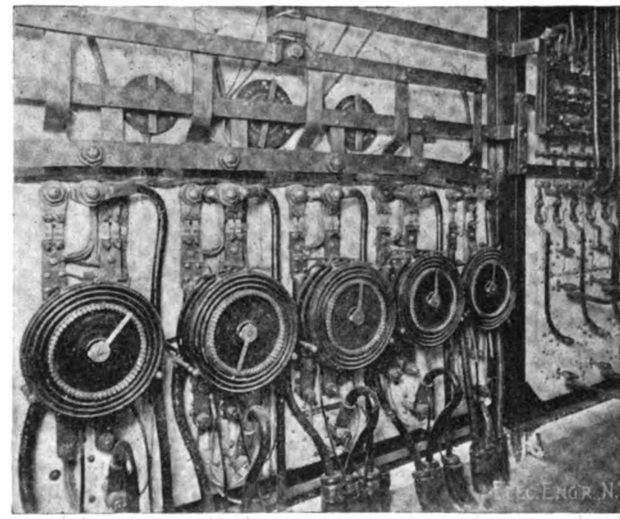


FIG. 4.—VIEW OF BACK OF SWITCHBOARD.

load to the firemen, so that they may be able to regulate the supply of steam according to the demand.

In order to reduce the number of ammeters required ammeter shunts are placed on all feeders, and a switch so arranged on the front of the board that by turning a handle

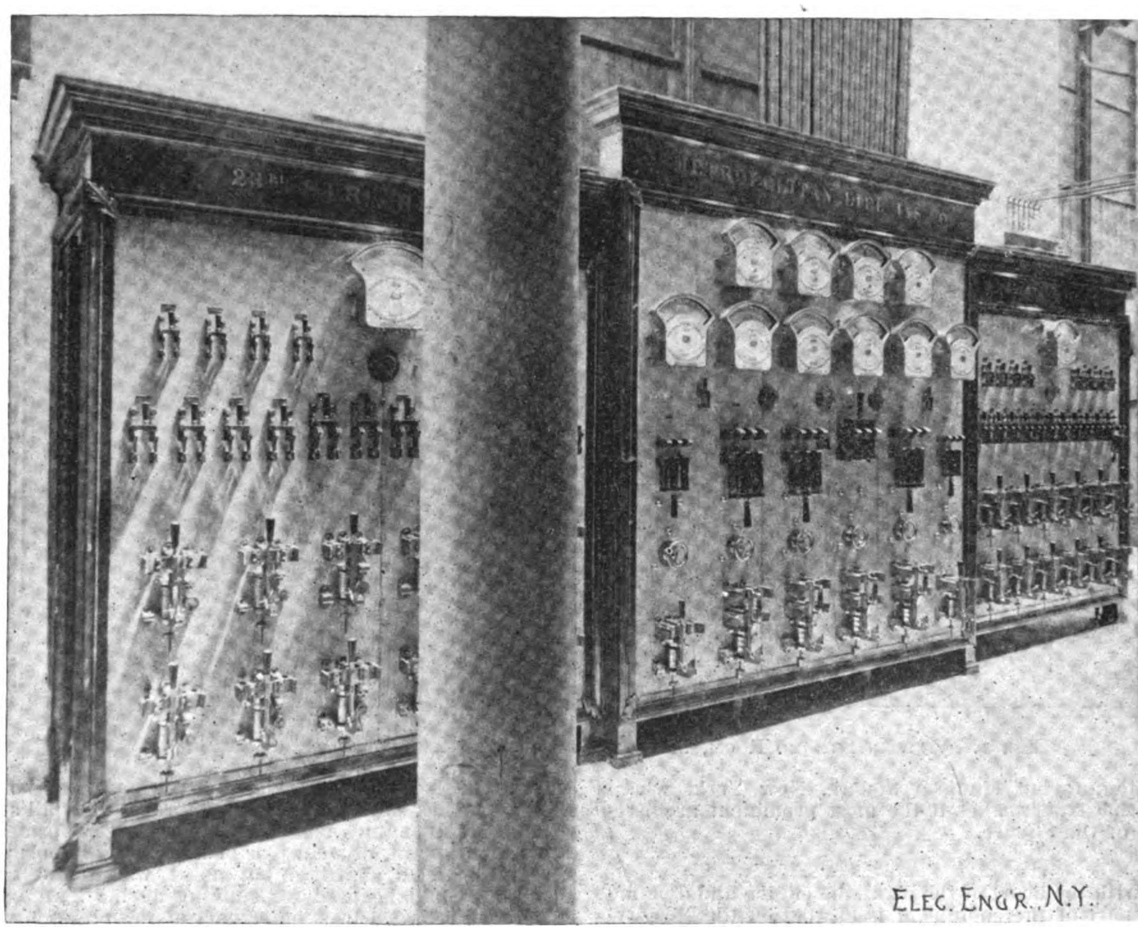


FIG. 3.—VIEW OF SWITCHBOARD, METROPOLITAN LIFE INSURANCE BUILDING, NEW YORK.

the ammeter is successively placed in circuit with each Fig. 4. Above these again are the main multiple-contact jaw switches, and then a row of Weston ampere meters. The board is also equipped with a differential galvanometer for throwing the machines in multiple, ground detector, and volt-

the ammeter is successively placed in circuit with each feeder. Great care has been taken in the construction of the switchboard, and especially with the joints. As shown in the upper right hand corner in Fig. 4, double bus-bars are employed on the back of the board for one-half the distance, and

double contact joints are employed. The feeder panels shown on either side of the central dynamo panel in Fig. 3 control, respectively, the Twenty-third street building and the newly added eleven story wing, controlling in all 4,340 lights.

Both these panels are also provided with Harrington circuit breakers, and in addition thereto fuses placed at the back of the board. This also holds true of the dynamo leads.

The switchboard is surrounded by a bronze frame, with solid bronze doors at each end, and the board stands out four feet from the wall, thus giving plenty of room for access. The cut-

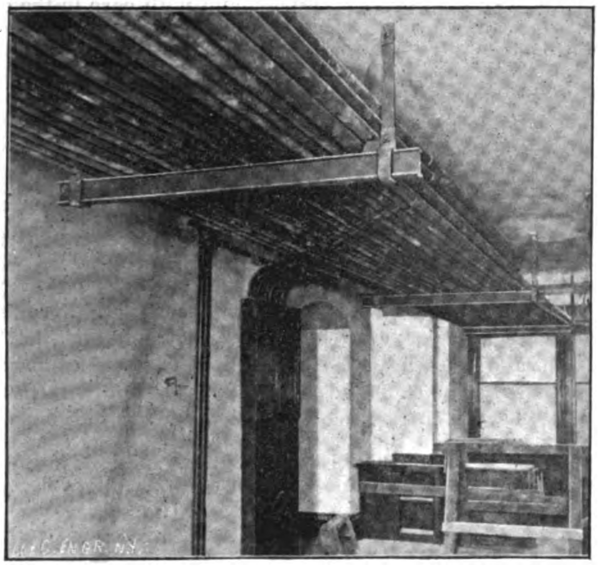


FIG. 5.—RUNWAY OF INTERIOR CONDUIT TUBING.

out panels are of marbleized slate, and the mountings in polished brass.

DISTRIBUTION.

From the switchboard the cables, of the Grimshaw type, rise in fifty-six interior iron conduits, of the Interior Couduit Company's type, suspended in the basement from the ceiling after the manner shown in Fig. 5. This runway of iron interior conduits is necessarily subjected to a number of curves before reaching the cable shaft, which is especially provided for that purpose, and this piece of conduit work is one of the finest which has yet come under our notice, doing infinite credit to those in whose charge it was placed. The extent of this work may be gathered from the statement that twenty-seven miles of duct, thirteen miles of feeders and thirteen miles of tap circuits are distributed in the building.

One feeder is provided for each floor, so that each floor can

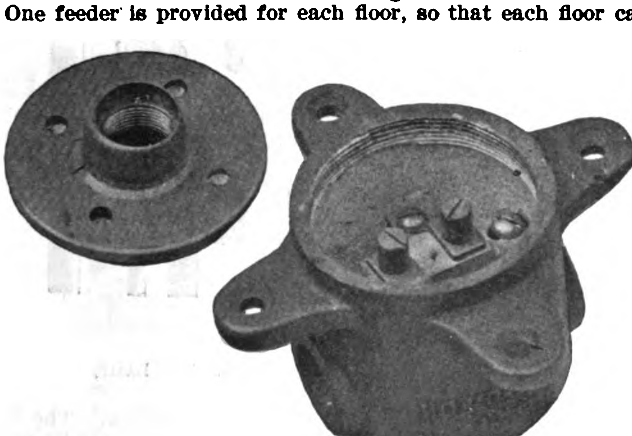


FIG. 6.—FLOOR OUTLET BOX.

be separately controlled, and in order to permit of easy manipulation iron gratings are provided at every floor level in the cable shaft. At the end of each feeder pipe a junction box is placed in the shaft, and the feeder then led through the wall of the shaft into the cut-out box. These cut-out boxes are designed so that the switches and cut-outs are placed together in the same cabinet enclosure, so that access to either can only be had by the person authorized to handle one or both. From each of these switches and cut-out boxes there are run four sets of submains on each floor. These again go to four locations, and from each of these points four submains are run, making eight centers of distribution on each floor.

The work of the Metropolitan Life Insurance Company requires the services of several hundred clerks and typewriters, and in order to avoid drop lights a special system of floor wiring was adopted by which the circuits are brought up directly beside the desk of each clerk. In order to accomplish this, floor outlet boxes, one of which is illustrated in Fig. 6, were designed, the construction of which is shown in the cross-section, Fig. 7. As will be seen, it consists of a cast iron pot, enameled on the inside, into the sides of which lead iron pipes carrying the conductors. Suspended in the center of the pot is an insulator, upon which are mounted the terminals, to which the conductors are connected. Four wings are cast at the side of the pot which are screwed into the rough floor, and the pot is closed by a brass cover, made watertight by a rubber gasket, the flat part of the cover coming flush with the finished floor. From the center of the cover rises a short threaded pipe section, into which is secured interior conduit pipe, finished at the top with a hard rubber cap, which screws soft rubber washers in contact with the top of the conduit

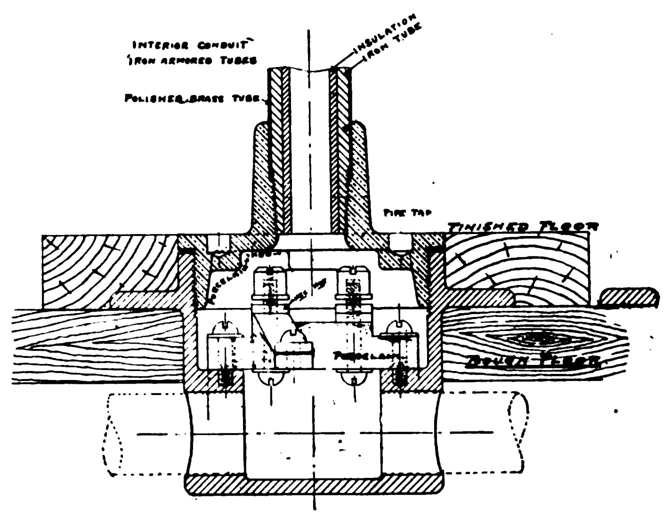


FIG. 7.—FLOOR OUTLET BOX.—SECTION.

pipe, thus sealing it hermetically. This gives a complete waterproof construction, and has proved a very efficient device. There are 544 of these floor outlet boxes, which were manufactured by Jos. DeRycke, furnishing 1,319 outlets. The magnitude of this part of the work will be realized when we state that are 4,000 lights for desk wiring, and 2,000 fixtures.

On the second floor of the building, which contains all the company's filing cases, 275 ceiling boxes are employed, each controlled by a Cutter flush switch, grouped in suitable panel boards. These iron ceiling boxes are covered by a 4½ inch block of hard wood screwed directly to the iron box. No cords whatever are employed.

The outlet boxes on the various floors consist of two slate boxes, one placed within the other, so that every possible precaution against fire has been taken at this point.

In this necessarily brief description of a plant containing many details we can give but a faint idea of the care and oversight with which the work has been carried out, and the result has been that the plant may well be considered one of the finest in the city. The entire work was carried out by the Western Electric Company, according to the specifications of the consulting electrical engineer, Mr. C. O. Mailloux.

PUBLIC ARC LIGHTING ON MOTOR GENERATOR AND CONVERTER SYSTEMS.

HIGH tension continuous supply systems possess one desirable feature. It is that arc lamps may be run in series across the primary mains, and all the advantages that are claimed to result from the adoption of rectifiers in alternate current stations are at once gained. The one set of plant can be run for the incandescent and arc lighting during the early hours of the morning, and no additional apparatus of any kind is required either in the station or at the lamps.

The engineers on alternating systems are divided in opinion as to the best manner of securing like benefits with their type

of plant. It has been proposed to run continuous current arc lighters from synchronous alternating motors, but the efficiency of this combination seems to be rather low and we are not aware that it has been adopted anywhere on a large scale.

In principle it is nothing else than another adaptation of the motor-converters used in the outlying portion of the Dublin tramway lines, and this will be fresh in the minds of our readers from the illustrations and description that recently appeared in our columns. As the arrangement was specially designed for power transmission, three-phase currents were adopted, but there is no reason why ordinary single-phase supply should not be utilized where, for the present at least, lighting forms the principal work of the supply concern. Instead, therefore, of running 500 volt dynamos, arc lighters might be so driven and the efficiency of the continuous current arc, together with the advantage of running only one unit of generating plant for the greater part of the night would result. Indeed, the whole object of Messrs. Hesketh and Gibbing's paper, read at the meeting of the Municipal Electrical Association last week, is to prove that the alternating motor-continuous-current-generator combination is a feasible and satisfactory method of tackling such branches of electrical work as require currents, popularly described as being of a different kind to that provided for the incandescent supply of a district.

A second method of meeting the conditions considered by some to be requisite for successful arc lighting is to install rectifiers. We have dealt with this phase of the question so fully in a recent article in these columns that it is unnecessary to say much more on the same topic, except to point out that rectifiers are running machinery and take quite as much attention as an arc lighter or motor-converter, while they do not hold in synchronism as steadily or strongly as would an alternating motor. Considering that a large number of alternating stations persistently run in parallel, and find no difficulty in so doing, it is evident that there need be little anxiety on the score of reliability with a synchronous motor.

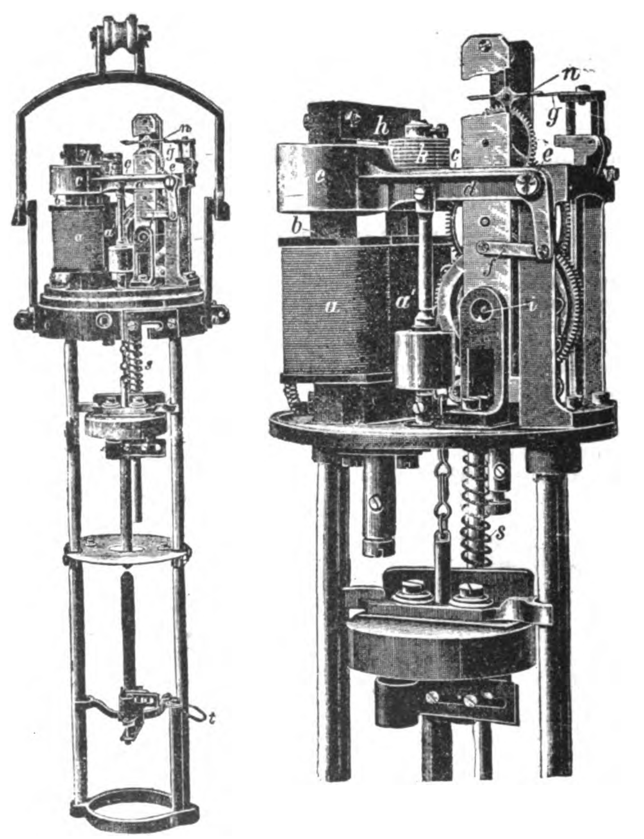
Although the alternate current arc is not itself so efficient a light-giver as the continuous, the exigencies of public supply have led to arc lighting by alternating lamps run off separate transformers, and the simplicity of this system has a great deal to recommend it. The effect and general illuminating qualities of a 600 watt alternating arc are quite as good as those obtained from a 500 watt continuous lamp, and what is lost in the arc, due to its intrinsic lower efficiency, is compensated for by the absence of losses elsewhere. Those who have seen the lighting of Hastings with Brush lamps, of Newport and Ayr with Lewis lamps, and the Crompton-Pochin lamps at Yarmouth, will appreciate the force of the argument. Of course, some engineers have thought it worth while to put in separate plant for arc lighting, and the Siemens constant current machine at Derby, the Siemens constant potential machines at Hampstead, and the Johnson & Phillips arc lighters at St. Pancras, are due to the strong opinions held by the designers of these stations.

Where high tension continuous currents are employed, the problem is one of details only. Thus, at Oxford, an experiment in public lighting was commenced two years ago, when the Corporation authorized the local company to erect and supply some arc lamps for street lighting, and, as the results were in every way satisfactory, the electric lighting is being extended on lines suggested by Mr. J. Hardie McLean. The number of lamps first tried was 16, and this number has now been doubled. The lamps are run 20 in series across the high tension 1,000 volt primary mains, being supplied direct from the station omnibus bars. The remaining 12 are connected two in series across the 100 volt low tension distributors. Twenty-four arcs are extinguished at midnight, and, when this occurs, a couple of 16 candle-power incandescents, carried by supplementary brackets on the column, are switched on. The other arcs, eight in number, are kept lighted during the hours of darkness. Mr. McLean has devised an automatic switch to extinguish the all-night arcs and incandescents at daybreak. This consists of a switch of the tumbler type operated by an electro-magnet, which is itself under the control of a clock. The switch is fixed above the electro-magnet, and the armature of the latter has a small connecting rod fastened to it and connected with the switch. In the upper end of this rod is a long slotted hole through which a steel pin fixed in the end of the switch lever passes. The clocks are wound daily by the lamp trimmers, and left set at the time when the lamps are to be switched off. When one of the clocks makes contact, its armature is pulled down by the magnet and a spring then comes into action separating the contacts, and the pin in the lever working in the slotted hole gives a quick break. As the magnet-circuit is broken at the same time, sparking in the contacts of the clock is obviated.

At Portsmouth, where the arcs and incandescents are also in use, the change-over from arcs to incandescents is effected by a polarized switch, brought into action by reversing the rectified current. As it is becoming general to run arc lamps off the low tension mains in large cities, a clock-switch that can be relied upon will prove a very useful appliance, and be an improvement on the bicycle switchman who is employed in the absence of a suitable automatic device. It appears that in America the tendency is to press up the number of lamps in series beyond even the present figure of 100; in this country there is evidence of greater success attending the running of lamps in parallel and utilizing the distributing mains for both private supply and public lighting. Alternating arcs are now being largely used by shopkeepers, and with care in the choice of carbons and proper adjustment, combined with the trend towards lower frequencies, there seems to be no reason why a similar course should not be adopted with them.—London "Electrical Review."

KOERTING & MATHIESEN'S ALTERNATE CURRENT SHUNT ARC LAMP.

INSTEAD of employing the usual attraction of a magnet in its armature for striking and regulating the arc, the inventors of the lamp illustrated in the accompanying engravings make use of the inductive repulsion of the rings placed in front of the poles of an alternate current magnet. For this purpose there is employed a horseshoe electro-magnet, having a core, b, and coils, a a', the ends of the core rising above the induction rings, c c'. These rings are cast in one with the lever d, and when no current is on the lamp the weight of the rings presses them upon the tops of the spools; but as soon as the magnet is energized the secondary current induced in the rings causes a repulsion in the direction of their axis depending



ALTERNATING CURRENT SHUNT ARC LAMP.

upon the current passing in the shunt winding. The bent lever, d, is thus turned on its pivot, e, and transmits its movement by means of the rod, f, to the wheel train, pivoted at i. The latter swings outwardly until the fan wheel, n, is released from the tappet, g, so that the carbons, which up to that point were separated, are forced together by the weight of the upper carbon holder. As soon as they touch each other the magnet is momentarily deprived of current and the rings drop by their weight, so that the wheel train swings back, thus causing the fan wheel to be stopped and the arc to be formed.

The subsequent regulation of the arc is evident. With the maximum potential, the induction rings are raised so high that the fan wheel is momentarily released from the tappet, g, thus

allowing the carbons to approach each other for a small distance, when the escapement is stopped.

In order to increase the inductive repulsion, the magnet core, b, is provided with a magnetic short circuiting bridge, h. This bridge would not be necessary if the magnetic lines passing through the rings were absorbed in their entirety, which condition is not attainable; the object of the bridge is to allow the leaking magnetic lines to get into action on the other side. The weight of the induction rings alone constitutes the greater part of the force opposing the inductive repulsion, but is supplemented by the weight of the discs, k, by the addition or removal of which the potential taken by the lamp is regulated. The lever, d, is made of aluminum, since this metal has the most favorable relation between specific gravity and specific conductance. The magnet with inductive repulsion with regard to its electrical properties is claimed to have an advantage over magnets with armature attraction, in that the position of the armature is without influence on the co-efficient of self-induction of the shunt coils, and hence the lamp potential remains unaffected by the position of the armature. From the mechanical standpoint another advantage is gained by the absence of a regulating spring, since alternating current lamps are continually subjected to vibrations which gradually cause the weakening of the spring. The lamp can be used equally well for single parallel work, as for grouping in series.

POWER TRANSMISSION.

THE LANGDON-DAVIES ALTERNATE CURRENT MOTOR.

SOME important improvements have been introduced into the design of self-starting, single-phase, alternating current motors by Mr. Langdon-Davies, who has succeeded in making marked advances in the direction of starting torque and efficiency in this class of machines.

The machine we are about to describe, which is being introduced by the Alternate-Current Electro-Motor Syndicate, Limited, London, has an efficiency, according to Prof. S. P. Thompson's report, of 91 per cent. at its maximum power, and also at half-power, whilst between these limits it rises to the high figure of 95 per cent. Further, even at one-third load its efficiency is 75 per cent. These figures are the more remarkable in that the motor tested was of but .85 horse-power, and it has long been recognized that in general small motors are much less efficient than large ones. Further, Prof. Thompson states that the motor will start under an absolute dead load, equivalent to about a quarter of its maximum torque, while further experiments have shown that in practice this figure may be doubled, or, if a slight sacrifice of efficiency is made, the starting torque can be still further increased.

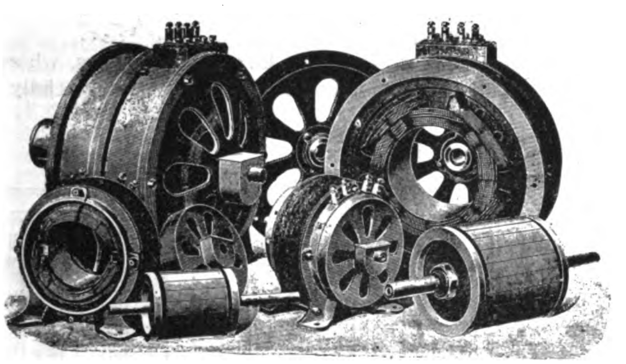
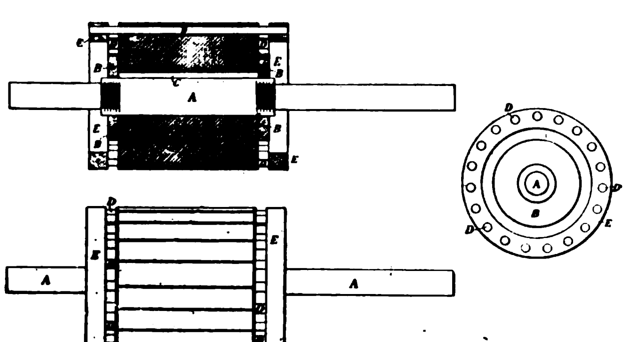
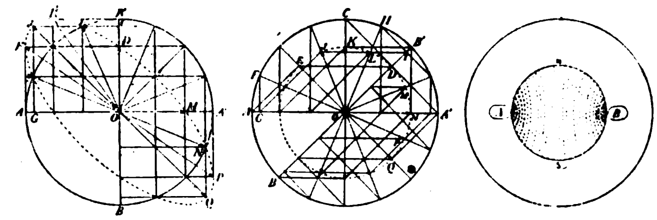


FIG. 1.—THE LANGDON-DAVIES ALTERNATING MOTOR.

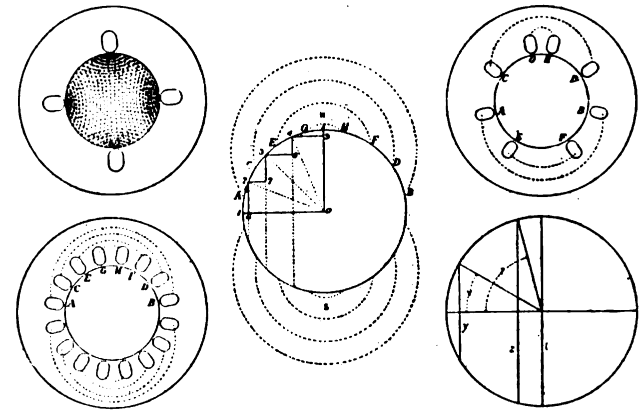


FIGS. 2, 3 AND 4.

The motor itself is shown in Fig. 1, which represents two different sizes of the motor, both complete and in their separate portions. Two of the armatures are shown lying beside their respective field magnets, while in Figs. 2 to 4 the construction of these armatures is shown in more detail. Each armature consists of a set of discs, Fig. 4, mounted securely on a spindle, A, between stout pressure plates, B, and insulated from each other in the usual way. Near their edges a number of circular holes are bored, through which pass stout copper rods, D, thoroughly insulated from the metal around them. These rods terminate at each end in stout copper rings, E. Opposite each rod, D, the armature is slotted longitudinally, as shown in Fig. 3, with a view to reducing Foucault currents.



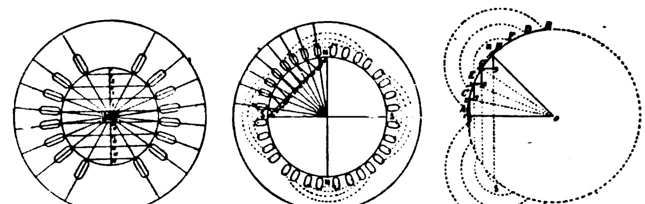
FIGS. 5, 6 AND 7.



FIGS. 8, 9, 10, 11 AND 12.

The field winding is explained in detail in Figs. 7 to 18, which represent the field magnet discs with their perforations. Through these holes are passed two entirely distinct coils of wire, arranged in such a way that when a current is passed through one coil it tends to produce poles in the ring in one direction; while if a current passes through the other coil it tends to produce poles at a direction making a definite angle with the previous one. The discs are clamped together inside a gun-metal casing, provided with flanges, by means of which the motor can be secured to any suitable foundation. Perforated covers are bolted on each end of the casing, and are fitted at their centers with bearings for the armature spindle.

It is not practicable to split a single-phase alternating current into two branches with a phase difference of 90 degrees, although it is easily possible to accomplish a phase difference of 45 degrees. If such a split current be supplied with two sets of coils wound at right angles to each other the resultant rotating field will not be uniform, as is shown in Fig. 5. Here A A′ and B B′ are the two axes of the coils, and the lines OF, OE, OJ, etc., show the magnitude of the resultant field at intervals of 1-16 of a period. Examining the ellipse which

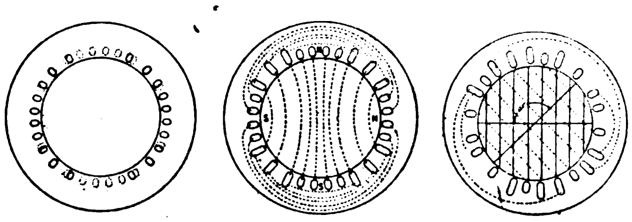


FIGS. 13, 14 AND 15.

bounds the line representing the intensity of the resultant field, it is seen that the strength varies, and that the angular advance is not uniform.

In Fig. 6 is shown the improved method of arranging the coils in the Langdon-Davies motor. The two axes of the field windings are inclined to each other at an angle of 180 degrees —45 degrees, that is, the supplement of the phase angle between the component fields (taken as before at 45 degrees). Following out the construction it will be seen that the curve joining the lines OE, OJ, OK, etc., is a circle. The resultant magnetic field is therefore of constant magnitude, and moreover it has a constant angular advance.

It has been found impossible to distribute the magnetic field in an alternate current motor as usually constructed with a



FIGS. 16, 17 AND 18.

squirrel-cage armature and small air-gap. This is shown in Fig. 7, which represents the test made with iron filings. It is evident from this that with a single coil of wire wound across a diameter there will be a constant magneto-motive force acting in the central space and the reluctance will be least at the edges and greatest at the center. It follows that the magnetic field will be densest at the edges near the winding holes in the core. Again, when two such fields are combined as in Fig. 8, the resultant field can never be uniform for any position of the coils.

In the improved motor the windings are distributed so as to compensate for the varying reluctances of the central space. For example, in Fig. 9, which shows the method of winding for a two-pole machine, a portion only of the winding is threaded through the holes A B, while another portion is threaded through C D, another through E F, etc. The several windings vary the magnetomotive force in proportion to the reluctance. The dotted lines show the directions taken by the windings in passing from hole to hole.

The number of the sections into which the winding is divided varies in accordance with the size of the motor. Three divisions are sufficient for the smallest class of two-pole motors, four or more sections for larger two-pole motors. The split current with a phase difference of 45 degrees between the two branches is obtained in the smaller motors by placing a non-inductive resistance in series with one of them and making the ampere-turns in each the same.

The coils are proportioned as follows: In Fig. 10 the points A, B, C, D, E, F, G, H correspond to equally spaced holes. The intervals between these points are bi-sected at 1, 2, 3, etc. From the neutral point 1 and from point 5 radii are drawn, meeting at 0. From 2, 3, and 4 perpendiculars are dropped on 0 1, and the horizontals 2 7, 3 8, and 4 9 are also drawn. Then the lengths 2, 6 — 3, 7 — 4, 8, and 5, 9 are proportional, respectively, to the numbers of turns of wire which should pass

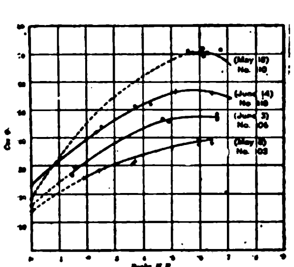


FIG. 19.

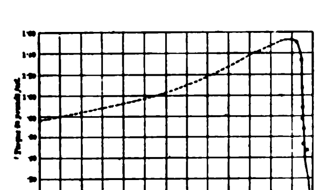


FIG. 20.

through the holes A B, C D, E F, and G H, respectively. The rule given has been deduced from the fact that the reluctance of the two paths represented in Fig. 12 by the lines y and z varies approximately as the sines of the angles Y and Z.

When the total number of turns to be wound on is but small, sufficient accuracy cannot be obtained with equally spaced holes, and it is then necessary to wind an equal number of holes in each section and to vary the distances between the holes as shown in Fig. 13. The vertical diameter is divided into twice as many parts as there are coils to be wound, as shown by 1, 2, 3, 4, etc. Then at each evenly numbered part, horizontals are drawn to meet the polar surface of the field magnets shown, and the holes for the windings are located on radii through the points thus obtained. Where a four-pole field is to be used, the method employed is shown in Fig. 15. As before, the windings in each coil must be proportional to the lines 2, 6—3, 7—4, 8, and 5, 9. If equal numbers of turns are desired through each set of holes, the latter may, as in the two-pole machine, be unequally spaced, as in Fig. 14. Here the line S N is divided into twice the number of parts required, and the holes located on the radii through the intersections of perpendiculars to the line S N at the even numbers, with the polar surface. In all these cases a single winding only has been dealt with, the requisite rotary field being obtained by superimposing two of these sets of windings, as already described. The same holes, or some of them, may be used to accommodate both sets of windings. Thus in Fig. 16 the full lines show the holes set out for one set of windings, and the dotted lines for another set. In practice the overlapping holes are adjusted so as to coincide, as in Fig. 17. Fig. 18 shows the arrangement of holes for the two sets of coils when the lag is 45 degrees, whereas Fig. 17 was designed for a difference of phase in the two sets of coils equal to 90 degrees.

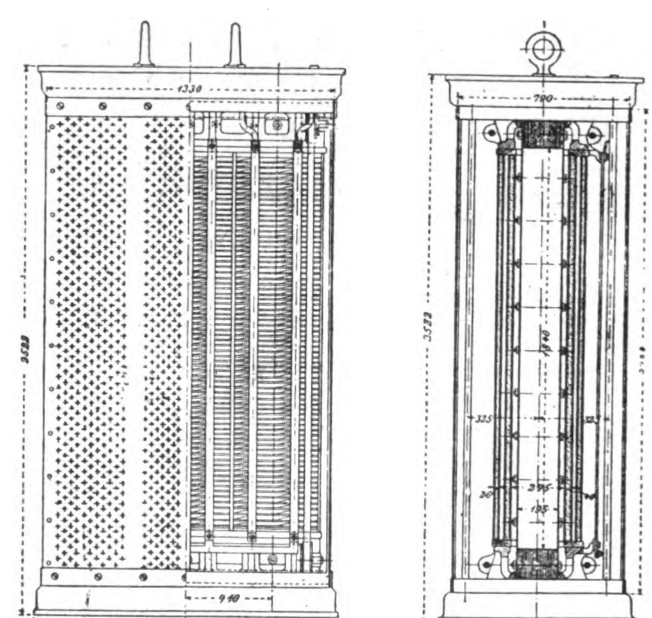
Figs. 19 and 20 show curves which were plotted from Prof. Thompson's test of a ¾ horse-power motor. It shows a good starting torque, although not so much as can be obtained with direct current machines. The power factor, Fig. 19, is considerably affected by very small details in the construction, as, for example, the width of the slots in the armature and field, width of the air gap, the number of bars in the armature and the number of sections per pole in the field winding.

TESTS ON LARGE POLYPHASE TRANSFORMERS.[1]

BY DESIRE KORDA.

NO general rule can be given for the dimensions of transformers. Cooling surface, efficiency, drop and no load currents, as well as cost, are all points which must not be lost sight of in designing and which involve at the same time some contradictory conditions.

This is the more important in large transformers, where the judicious choice of form and dimensions is made especially difficult on account of the limited cooling surface which is obtainable. There are indeed transformers which cannot stand their originally intended full load, in spite of high efficiency, partly on account of the large drop with induced load. Usually it is, on account of the insufficient cooling surface, partly preferable to use several small transformers in place of one



FIGS. 1 AND 2.—160 KILOWATT ROTARY CURRENT TRANSFORMER.

[1] "Elektrot Ztschr."

large unit. This is, besides, more advantageous, above certain sizes, on account of the idle currents, inasmuch as the transformers may be put into circuit according to demand. Nevertheless, the lack of room or first cost often causes one to decide on transformers of above 100 kilowatts, and, indeed, more frequently so, as one would think, judging by the few publications on the action of such transformers in literature on the subject.

It, therefore, seems to me to be not uninteresting to give a few experimental results, which I have made on two transformers of 160 kilowatts, which were intended for an inductive load of 185 kilowatts and which was carried out by the Fives Lille Society for a large hydraulic polyphase current installation.

Figs. 1, 2 and 3 show the construction of these transformers. They consist of three vertical sections in one plane, closed above and below by cross yokes. This form is preferred on account of the easy construction and assembling. The ratio of transformation is 1 : 100 with principal voltages of 72 and 7,200, respectively, and corresponding to a phase potential approximately of 41.5 and 4,150 volts, respectively. The periodicity is 50 per second.

The coils are wound one within the other, the high-voltage ones being within. Both are a radial distance of 15 mm. apart, separated by two paper cylinders and an air gap of 10 mm. Cooling is increased in consequence of the air draught, especially since the cooling surface is practically doubled. Finally it can be stated as an advantage that the tube thus formed can be used to hold a rope in lifting out the low-voltage coil when the transformers are being taken apart.

The winding consists of 66 parallel wound spools of twelve convolutions each. The ends of these spools are soldered to copper lasts, of which three are connected by one copper strip, which in that way form the neutral point of this star winding. The other three strips are used for the conduction of the current. The spools consist of rectangular wire of 20 square mm. cross section.

The resistance of the low-voltage winding is .000143 ohm, that of the high-voltage winding 1.5 ohms. The total weight of the copper is 1,460 kg. With a cross section of the iron of 332 square centimetres the maximum magnetic induction is 4,700 C. G. S., the total weight if iron is 2,070 kg.

The iron losses were measured by means of the wattmeter, with no load and the following values were found: While the no-load current in the outer sections in the low-voltage winding amounted to 60 amperes and in the winding of the middle section only 50 amperes, the wattmeter which was inserted into each of the three-phase windings read but 1,133 watts in the outer and 1,415 watts in the middle sections.

These differences can be explained thus: For the middle section the magnetic circuits are symmetrically situated and shorter than for the two outer ones, consequently the leakage is smaller than in the latter. Thus on the one hand the no-load currents become smaller, while on the other the iron losses become greater for the middle sections, for almost all lines of force go through the iron, causing hysteresis and Foucault currents, while the dispersed lines of the outer sections in the air have no such corresponding losses. In a similarly constructed transformer of 120 kilowatts I could determine the identical relations. While in the outer sections the idle currents were 37 amperes and the iron losses 708 watts, the corresponding figures for the inner sections are 28 amperes and 836 watts.

From the observed values we find for the 160 kilowatt transformer as watt currents, with no load:

$$1133 \cdot 41.5 = 27.5 \text{ amperes}$$

and

$$1415 : 41.5 = \quad 34 \quad \text{"}$$

and therefore as magnetizing currents for the outer sections

$$\sqrt{60^2 - 27.^2} = 53.5 \text{ amperes},$$

and for the minor ones

$$\sqrt{50^2 - 34^2} = 36.5 \text{ amperes},$$

corresponding to a lag with no load of cos. $\phi = .45$ and .705, respectively.

Judging by the above, symmetrically arranged magnets, such as the triangular (Oerlikon), or star arrangement (Siemens), would be preferable to three sections lying in one plane. But by putting on the load these differences become negligible.

According to the above values the total loss in the iron = 3,681 watts. On the other hand, the copper losses in work equivalent to 160 kilowatts, to which correspond 1,280 amperes in each of the low-voltage spools is 1,500 watts, from which we get an efficiency of 97 per cent. The outer surface has without the air gap 85,000 square centimetres between the spools, corresponding to a cooling surface of 17 square centimetres per watt lost. Through the air gap this cooling surface is at least doubled.

To determine the drop on account of magnetic leakage Kapp's method was used. The high-voltage spools were short circuited and the potential determined which had to be supplied to the low-voltage spools to cause the normal current in the short circuited spools. In the first measurements 8 to 10 per cent. drop of the normal potential was found with 1,500 amperes. The cause of this was discovered later when it was found that a large part of this loss was caused by C^2R losses, inasmuch as the copper connections heated up.

With a load of 12.5 amperes in the short circuited spool, to which corresponded 1,280 amperes in the primary winding, four volts difference of potential was found between any two phases and the differences for the three sections were quite negligible. The above currents correspond to a load of 160 kilowatts. On the other hand, with 185 kilowatts, that is, with 14.5 amperes in the short circuited and 1,500 amperes in the primary coil the

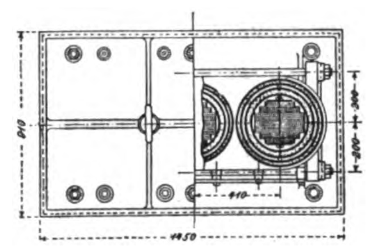


FIG. 3.

recorded voltage was 4.5 volts. In the first case there was therefore necessary 5½ per cent., in the second 6 per cent. of the normal voltage (72 volts) for the production of normal current strength.

Since every winding shows .5 volt drop, we find from Kapp's diagram that the drop of potential with an induced load of cos. $\phi = .85$, is but 1½ to 2 per cent. In feeding incandescent lamps the drop would be still smaller. In supplying motors, especially large ones, with an efficiency of not less than 70 per cent., these transformers do good service and in a combined service of motors and lamps the fluctuations are still permissible.

ELECTRIC TRANSMISSION ON THE PACIFIC COAST.

THE incorporation of the Pacific Transmission Company, of San Francisco, marks the beginning of an interesting project for the electrical transmission of power from the mouth of California coal mines. The company will be controlled by the San Francisco and San Joaquin Valley Coal Company, whose mines are at Corral Hollow in Alameda County, and is one of several important undertakings connected with that corporation. The new company will have a capital of $3,000,000, and will be empowered to build and operate steam and electric plants at the coal mines in Corral Hollow and Alameda County for the purpose of generating electrical power and furnishing the same by transmission over wires to Oakland by way of Livermore, Haywards, San Leandro and other towns en route, and also to San José and to Stockton. It is intended to ultimately extend the service to San Francisco. The cheapest item connected with the generation of the electrical power will be the fuel, which will consist of the waste and refuse screenings, dust, etc., from the coal produced at the extensive Corral Hollow mines. The supply of this kind of fuel will be almost inexhaustible, and as it is extracted from the mines with the merchantable coal, it is all paid for by the latter. As the coal company will control the transmission company there will be no charge for this fuel. The plant at the mines will generate at the start 6,400 horse-power, of which about 5,000 horse-power will be supplied to San José and to Oakland, though the towns en route, and afterward Stockton will be taken in, and if necessary the supply can be increased so as to extend the service even to San Francisco and other more distant points. The company expects to furnish this power to Oakland, San José, Stockton and intervening places at $60 per horse-power per year. The present cost ranges from $60 to $80, according to conditions.

HARD CARBON.

M. Moissan is reported, according to "Nature," to have discovered a substance harder than the diamond, in the form of a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of 5,000 degrees. This compound is black and not unlike graphite in appearance. It will cut diamonds without difficulty, and it can be produced in pieces of any required size.

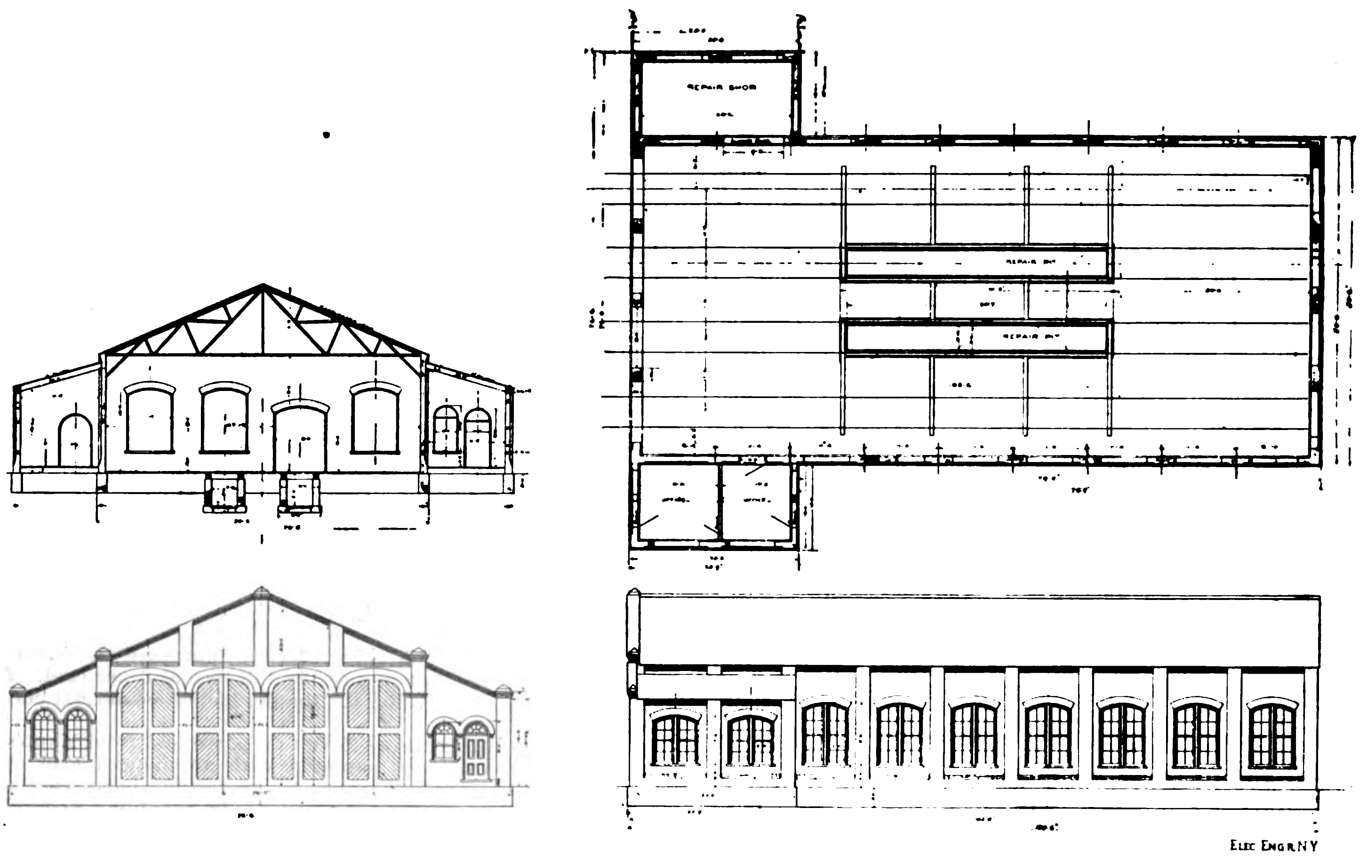


Fig. 1.—Car Barn of Dayton Traction Co.—Plan and Elevations.

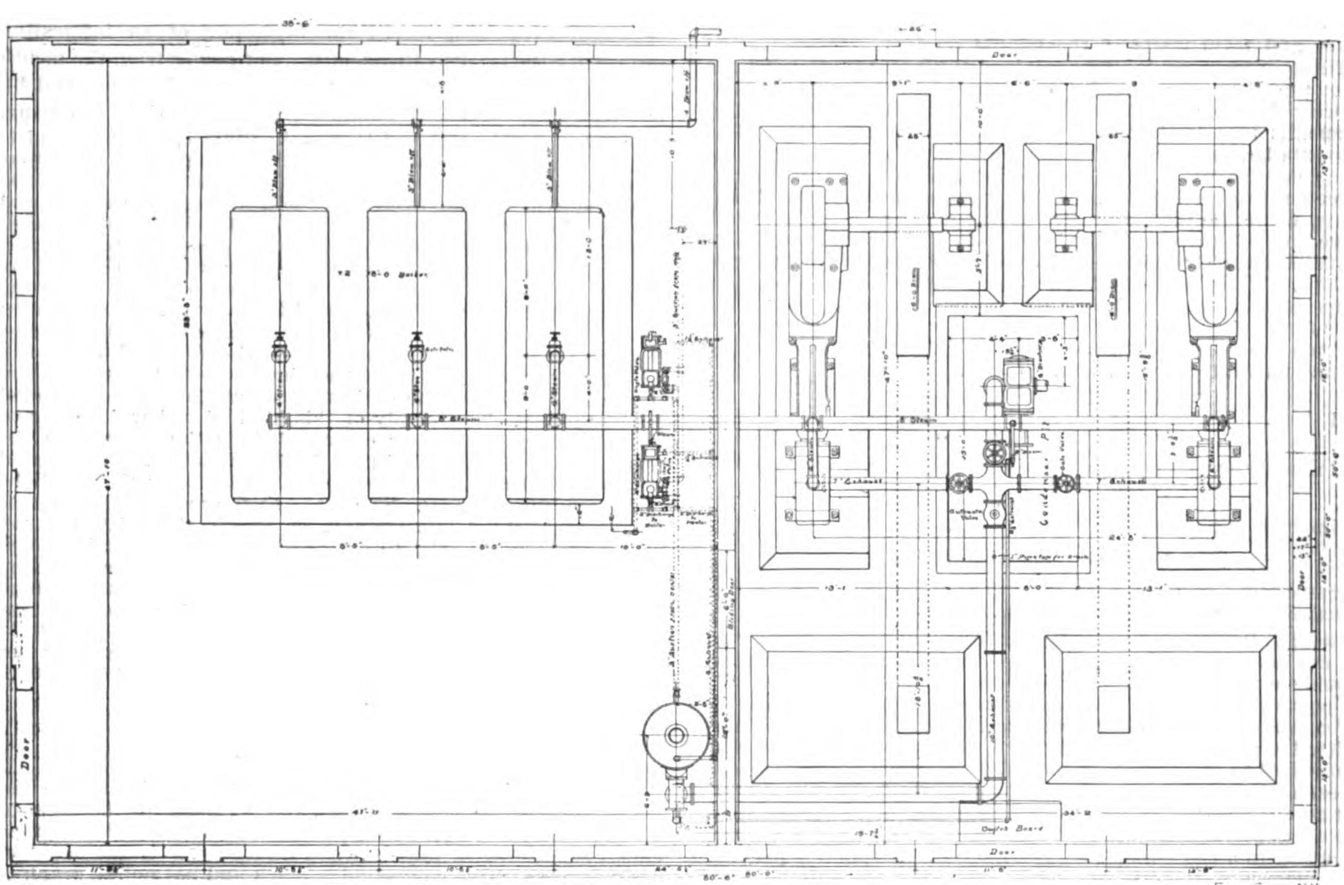


Fig. 2.—Power House of the Dayton Traction Co.—Plan View.

Electric Transportation.

THE DAYTON TRACTION COMPANY.

ON July 1 the electric railway connecting Dayton with Miamisburg, O., was opened for traffic and the results already achieved have more than realized the expectations of its projectors.

LINE AND TRACK CONSTRUCTION.

In connecting the two cities by means of an electric railway the Traction Company has followed steam railroad practice closely. The roadbed is solid, having heavy rails laid thereon, the cars commodious and strongly built.

The line is practically a direct one, although there are various angles; still the curves are so easy, of such large radius and the tangents so long that they are not objectionable. The road with turnouts and double track is 12½ miles in length, with a standard gauge of 4 feet 8½ inches. The roadbed is graded to proper elevation and is furnished with a most complete system of stone, brick and pipe culverts to successfully carry off all drains, giving absolute protection to the roadbed, and a 68-foot steel single-span bridge has been erected over the Miami Canal at Carrolton.

The rails are 60-lb. section; six-hole, double angle joints are used, provided with ¾-inch bolts, nut locks and washers. Two thousand five hundred ties, 6 x 6 x 7, are laid per mile and the roadbed thoroughly tamped and packed with gravel and stone under and between the ties.

The overhead electrical line from the city of Dayton to Miamisburg is standard bracket construction, heavy wrought iron brackets secured to wooden poles being used. In the city of Dayton and Miamisburg cross suspension construction is employed, iron poles being used. All line material is of the General Electric make and the feeders are carried along the entire length of the line with feeding-in points every 1,000 feet The system has ample protection from lightning and the greatest care has been exercised in having the trolley wire in perfect alignment with the center of the track to enable the running of the cars at the highest rate of speed possible.

THE CAR BARNS AND POWER STATION.

The car barn and power station have been erected at a point midway between the two termini and so situated as to enable the bringing in of coal at one side; and it is in close proximity to water of excellent quality and sufficient quantity for steam making and condensing.

These buildings are constructed entirely of brick and steel. Steel columns and trusses carry the roof, and the walls are built of brick encasing the columns so as to conceal the iron work, thereby adding greatly to the ornamentation and appearance of the buildings. The roofs of both power house and car barn are built of corrugated iron and that of tne power house is lined with hard wood, making the same moisture proof.

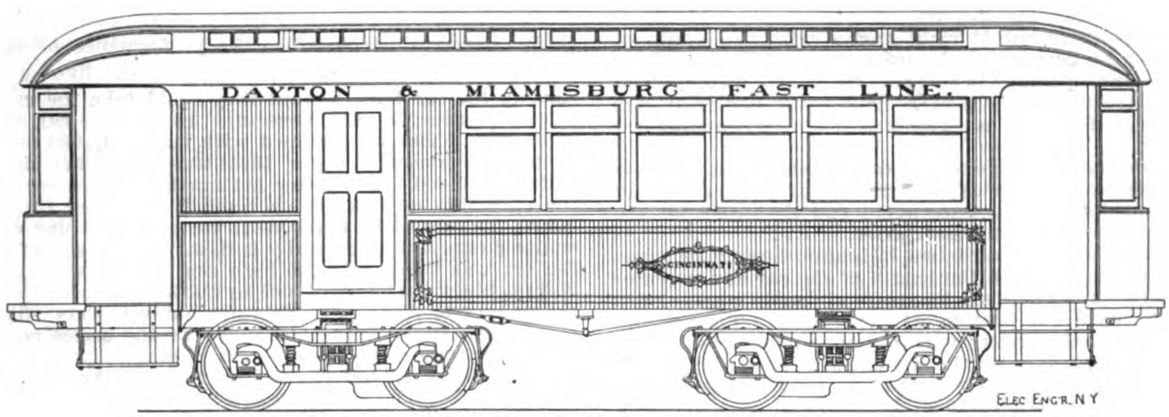


FIG. 3.—COMBINATION CAR, DAYTON TRACTION CO.

The car barn, shown in plan and section in Figs. 1 and 2, is also fireproof, and its dimensions are 75 feet in width by 105 feet in length. The car barn contains every convenience for repairs and handling of cars. Two pits, each 65 feet in length have been built of brick. The repair shop has been built at one side of the car barn and upon the opposite side are two offices, one for the general superintendent and the other for motormen and conductors.

The power station is 80 feet by 50 feet, and the interior is divided by means of a fireproof wall, the building being practically fireproof.

The steam plant is most efficient and economical. This is due to the ideal location of the plant. The boilers consist of a battery of three boilers, each 18 feet long, 72 inches in diameter and containing 72 4-inch tubes. The boilers are made of the best quality flange steel, triple riveted, and made to carry a working pressure of 125 lbs. per square inch.

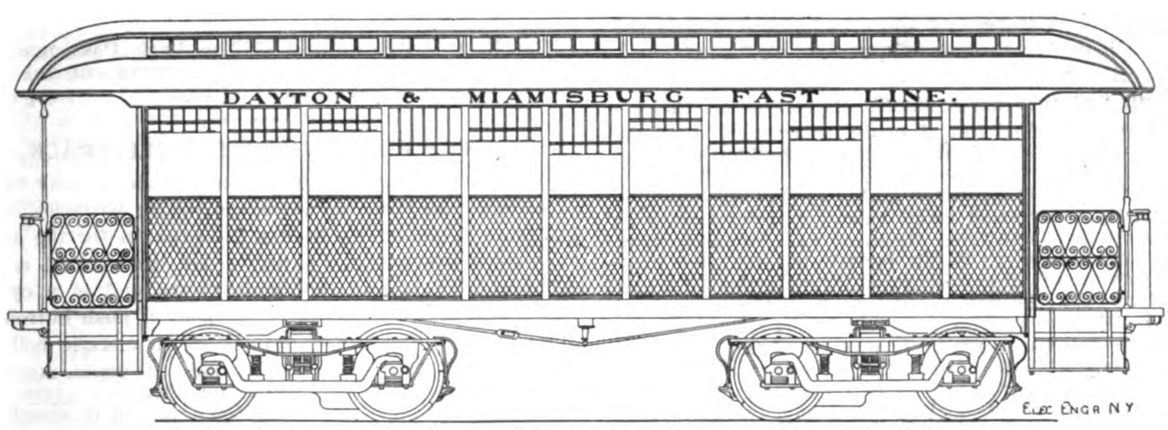


FIG. 4.—TRAILER, DAYTON TRACTION CO.

The smokestack to furnish draft for these boilers is made of steel, 60 inches in diameter and carried 102 feet above the grate service of the boilers. The stack is made of small sections of steel riveted together, and has an ornamental top and ladder.

To drive the two generators two 18 x 42-inch Hamilton-Corliss condensing engines have been installed, erected upon foundations built of brick seven feet in depth. Two General Electric 200 kilowatt multipolar generators furnish the necessary current for the operation of the road, each dynamo and engine being sufficient to operate the road in its entirety, so that the

plant consists of two duplicate units, thus guaranteeing the greatest regularity of service.

The switchboard consists of three separate panels; a panel for each of the generators and another for the feeders, switches and controlling devices. The switchboard is built entirely of slate and steel.

THE ROLLING STOCK.

The motor cars are of modern design and similar in appearance to standard steam railroad cars, built by the Barney & Smith Company. They are 35 feet long, vestibuled at both ends, 8 feet wide, and mounted upon double trucks, having all wheels 33 inches in diameter. They are straight sided with steam car roofs. The interior finish is of extra quality and of hard wood. The windows are large and double, and special arm rests have been provided.

The seats are arranged at right angles with the length of the cars, having a center aisle between them. They are fitted with springs and upholstered in cane. There are two rows of double seats, seating in all 36 passengers. The center aisle is 18 inches wide. Each car is lighted with ten 16 candle-power lamps.

The combination baggage and express car, shown in Fig. 3, is similar in appearance to the car described above, but consists of two compartments, one for passengers and the other for the carrying of baggage and express matter.

The trail cars, Fig. 4, are 34 feet in length, having seats arranged at right angles with the length of the car and a center aisle between them. There are two rows of double seats, eleven on each side, each car seating 44 passengers. Trailers are lighted by means of couplers with ten 16 candle-power lamps and in the same manner as the motor cars. The sides of the trailers are provided with wire guards to prevent accidents.

The motor cars are equipped with two 50 horse-power General Electric motors each (100 horse-power per car), with controllers on both platforms.

All work has been done by and under the direct supervision of Messrs. Stern & Silverman, Philadelphia, Pa. The officers of the company are Hon. Judge Dennis Dwyer, president; O. B. Brown, treasurer; O. M. Gottschall, secretary, all of Dayton, O.

THE EFFICIENCY OF COMPRESSED AIR FOR STREET CAR MOTORS.

BY R. LUNDELL.

GENERAL HAUPT'S reply to my article under the above heading in The Electrical Engineer of July 8, gives me the impression that he has either merely glanced over the article, or that he has completely failed to understand it. See line 32, etc., where General Haupt says: "Mr. Lundell thinks that to obtain the same results in speed, etc., under street railway conditions the horse-power must be at least doubled, evidently assuming that increasing the speed and doubling the horse-power will double the consumption of air," etc.

If General Haupt will take time to read my paper over slowly he will find that his elaborate statements in this respect are entirely uncalled for. I made no assumption in the matter of how much more air it will take to double the horse-power.

In regard to my opinion that "under street railway conditions the horse-power must be at least doubled," I wish to say that this opinion is founded on an actual test made upon a trolley car running on the Coney Island and Brooklyn Railroad. One section of this road runs through the city and another section runs through a level part of the country to Coney Island. The track of the latter section is similar to that of an ordinary small steam road. It was found that the average city speed could be maintained on the T-rails with about half the consumption of current. This fact made me believe that the air motors ought to have twice as much power when used on city roads. But my article was strictly confined to the matter of efficiency or the ratio of out-put to in-put and the above is immaterial.

On line 73, etc., General Haupt says: "Mr. Lundell gives an elaborate calculation on the efficiency of air compression to demonstrate that to compress 3,600 cubic feet of free air per minute to 2,000 pounds will require 2,480 horse-power," etc. General Haupt comes near being right when he states that any maker of first-class air compressors would guarantee to compres 3,600 cubic feet per minute with about one-half of 2,480 horse-power. This agrees quite well with the figures I finally used in my article.

General Haupt evidently does not see that the figure 2,480 is for adiabatic compression and that it is not used at all. It merely indicates the worst condition. If I had used this figure the efficiency of storage alone would only have been 27 per cent., and the total plant efficiency $.27 \times .70 \times .75 = 14$ per cent. According to the figure 1,133 horse-power, which is for isothermal compression, the efficiency of storage would be 44 per cent. Even this figure was not used, as it would have been too favorable. But the figure 40 per cent. efficiency, which was used, is so very near the best condition of 44 per cent. efficiency that it cannot be considered unfair.

AQUATIC PERFORMANCE OF STREET CAR MOTORS

The qualities of an electric motor are best shown in the ability of the device to withstand the extraordinary conditions to which it may be exposed. On March 1, 1896, a very heavy freshet flooded the streets of Derby, Conn., and Superintendent B. W. Foster thus describes the performance of one of his cars: In order to bring our employés, who live on the East side, to the car barn so that they could take the cars out on scheduled time, it was necessary to run the car across the causeway. This car, equipped with two G. E. 800 motors, had to proceed through water that was 22 inches deep for a distance of 600 feet. After getting them over we continued the operation of this car on regular scheduled time for two hours, making eight trips, until we could get one of our old summer cars to be drawn by horses. At the end of each trip the car was taken into the barn and carefully examined, the bottom plugs being taken out to allow the water that was in the motors to drain off. This amount was very slight. The power was used on the last notch of the series connections. The wave caused by the motion of the car was sufficient to come up under the bumper and wash across the front platform, so that during one-half of each round trip the resistance boxes were practically submerged.

THE COLUMBIA AND MARYLAND ELECTRIC RAILWAY.

Contracts have been awarded by the Columbia and Maryland Electric Ry. Co. for the overhead work on the city portion of its line, extending from Howard and Saratoga streets to Calverton road and Edmondson avenue, to Thomas C. Basshor for the poles, and to the Maryland Manufacturing and Construction Company for the other material. A contract for thirty-two 100 horse-power motors and twenty 30 horse-power motors has been awarded to the Westinghouse Electric Company. The larger motors will be used on the through cars between Baltimore and Washington, and the smaller ones will propel the cars running between Baltimore and Ellicott City. The contract for building the power-house at Paint Branch, Hyattsville, has been awarded to Henry Smith & Son, of Baltimore, for $81,500. The power-house will be a brick structure, 205 feet long and 130 feet wide. The plans were prepared by Henry Brauns, architect.

The East Baltimore and Clifton Park Passenger Railway Company have been incorporated to carry out the proposed extensions of the Suburban Company.

THE PUSH BUTTON BICYCLE TRACK.

An electrician says he has found a quicker way of making a fortune than running wires and selling batteries, and judging from appearances, he has good reason for the statement, says the Pittsburg "Dispatch." He has erected a platform 100 feet long and 10 feet wide at the end of a cycle path. Down this platform is ranged a series of push buttons, which are connected through a battery to an electric bell and an annunciator. The rider, having paid 10 cents, starts at one end and tries, in riding down the line, to depress as many of the buttons as possible. When a button is struck the bell rings, and the annunciator registers the particular button. The rider who is successful in guiding his wheel tire over all the push buttons wins 50 cents. This new diversion has created an extraordinary furore. The lucky inventor has organized a company which will sell the platforms outright, and give territorial protection to purchasers during the life of the patent. As a drawing card for owners of seaside and country pleasure resorts the new diversion would seem to be unique.

LIEUT. MANNING K. EYRE has been appointed manager of the General Electric Company's lamp works at Harrison, N. J. The appointment was in the nature of a promotion in recognition of Lieutenant Eyre's excellent work in the executive management of the lamp works.

ELECTRIC RAILWAY IN VERSAILLES, FRANCE.

Versailles, France, is to have an electric street railway and within two months the old horse cars will give way to the new system. The street railway will be run from the light and power station.

The steam generating plant will consist of four semi-tubular boilers supplying steam to four horizontal single cylinder engines aggregating 350 horse-power for the light and power service in the city and two steam engines aggregating 240 horse-power for the street railway. The electric generating plant will consist of two General Electric monocyclic machines aggregating 250 kilowatts and two direct coupled railway generators aggregating 200 kilowatts. The rolling stock will be 15 cars, each equipped with G. E. 800 motors and controllers.

The installation will be carried out for the Société Versaillaise de Tramways et de Distribution d'Enérgie Electrique by the French Thomson-Houston Company, of Paris.

ROENTGEN RAYS.

EXPERIMENTS ON ROENTGEN RAYS.

MR. T. C. PORTER, of Eton College, has written to "Nature" describing some curious results of experiments on Röntgen rays. He states that after examining the fluorescent and photographic action of the rays (X_2) emitted on strongly heating a "focus tube," and finding them different to the rays which have been hitherto noticed (X_1), in that the relative transparency of flesh, bone, aluminum and glass differs for the two kinds of rays, it seemed desirable to try the effect of cooling the tube. Solid carbon dioxide and ether, and then solid carbon dioxide alone were employed, with the result that in both cases the fluorescence of screen and tube very rapidly died out and the current apparently failed to pass through the latter; as the tube gradually grew warm again, the fluorescence in it returned, not gradually, but very suddenly, at a temperature not very far below that of the room, the glass lighting up brilliantly, and the shadows of the bones showing on the screen with increasing distinctness, the emission of X_1 rays reaching a maximum at about 12 degrees C. (a rough guess). On further heating X_2 rays begin to be evolved, judging from the increasing opacity of the flesh, whilst at the same time the fluorescence excited on the screen grows rather brighter. As the condition for the maximum of X_1 rays probably varies to a certain extent with the different forms of tube, and even different specimens of the same kind of tube, with the degree of exhaustion, etc., it seems to follow from these experiments that in some cases warming the tube slightly might be useful in photographing the bones, while in others moderate cooling would be better; and from the accounts of various operators such would seem to be the case, though the particular method of heating or cooling is an important factor in the result. Solid carbon dioxide seemed very opaque to the rays when its low density is considered, but the effect may have been partly due to the frost condensed upon it from the air.

The X_2 rays seem to discharge a charged plate whether positively or negatively charged, but of this he could not at present feel quite sure. Aluminum seems so far opaque to them that it is doubtful whether, when a screen is used, any of the rays get through, and when a screen is not used, one cannot feel certain that the effect observed is due to the X_2 rays either wholly or partly. After heating the tube and turning on the current, the whole tube is filled with a whitish, lavender-colored light, which comes to a focus on the glass behind the cathode, above or below it; and while in this state and giving little or no fluorescence on the screen, the tube does not charge an unscreened insulated plate, but it does rather rapidly drain it of a previously communicated charge, either positive or negative. As the tube cools the lavender light retreats more and more from the cathode till at last it reaches the upper edge of the rectangular anode, when the positive charge, mentioned before, begins to be given to an uncharged insulated plate, but very slowly; as soon as the center of the anode is bare of the lavender discharge, the potential of the unscreened plate very rapidly rises, and by the time the whole anode is clear of the lavender light the normal positive charge is re-established on the insulated plate. When the lavender glow retires from the cathode, it leaves behind it a space full of almost invisible light, which excites whitish green fluorescence on the glass of the bulb, and it is during this time that most of the rays are X_2, as is shown by the fluorescence screen, and photographs of a hand.

CATHODE RAYS AND X-RAYS.

PROF. SILVANUS P. THOMPSON describes some experiments on X-rays in a letter to the London "Electrician" as follows: Some experiments I am making on the connection between cathode rays and X-rays have just given me a result which it seems desirable to publish without delay for the benefit of other workers. Having designed a tube with the now usual oblique anti-cathode or "reflector" of platinum to receive the impact of the cathode discharge and generate X-rays, and an interiorly projecting wire of aluminum in the path of the latter rays, I have found that, with a sufficiently high exhaustion, there were produced simultaneously two shadows—an X-ray shadow on a luminescent screen outside the bulb, and a cathode ray (or Crookesian) shadow on the glass wall of the bulb. Both shadows were thrown as from the "reflector" as origin; but while the cathode ray shadow was capable of being deflected both magnetically and electrostatically, the X-ray shadow was not so deflected, even though the wire object within the tube was itself electrified either + or —. A slight shifting of the X-ray shadow was traced to a small change in the apparent origin of the X-rays, as the cathode discharge fell more on one spot or another of the platinum "reflector." At no state of exhaustion did the "reflector" convert all the cathode rays into X-rays.

FLUORESCENCE VISIBLE AND INVISIBLE.[1]

THERE has been some discussion in the Société Française de Physique on the subject of the nature of fluorescence, and particularly that produced by the Röntgen radiations. The subject is one which has at present only a purely scientific interest, and it is therefore left to those who are willing and able to spend time on the researches necessary to complete the theory of light and enable a rational account to be given of the new phenomena. But in view of the possibility of a fluorescent lamp being the ultimate result of the vacuum tube experiments now being made in the United States and elsewhere, the whole subject may any day become one of great practical importance. It has been known for some time that uranium salts and metallic uranium itself under the action of ordinary light emit radiations which are invisible to the eye, but can be reflected and refracted to a certain extent, while so far as concerns their action on a photographic plate and their power of passing through substances which are opaque to ordinary light, they resemble the Röntgen radiations. Most of the work in this direction has been done by Mr. Becquerel, but other investigators have obtained somewhat similar results with other substances, though the effect is not nearly so enduring as with uranium salts. Now, in general, in the process of fluorescence the radiations given off are of greater length than those received by the fluorescing substance, and Stokes' law, as it is called, is the expression of the theoretical reason why on the whole it should be so. But if the hypothesis is correct that the Röntgen rays and the uranium radiations belong to the region beyond the ultra-violet, we have apparently a direct contradiction of this, and what looks like a case in which the wave-length is shortened, which, of course, is just what is wanted to be done in order to utilize the energy wasted in producing invisible "heat" waves in almost every known form of artificial illumination. But at the Société it was pointed out by Mr. Guillaume that if a sufficiently complicated structure was assumed it was not theoretically necessary that there should be a degradation of all the wave-lengths, provided that the average length was lowered. It was therefore not impossible that a part of the emitted rays might have a shorter wave-length than the primitive radiation, provided that there was at the same time a sufficient amount of radiations of greatly increased wave-length. The subject is one of great difficulty both from a theoretical and an experimental point of view. Indeed, owing to the non-homogeneous character of the radiations, and the impossibility of sifting them out, so to say, no two observers seem to get exactly the same results. But it seems at least probable that the theoretical difficulties which have been believed to block the way to an efficient fluorescence lamp do not really exist.

ROENTGEN RAYS ON A NILE EXPEDITION.

So thoroughly practical are Röntgen rays considered by the Medical Department of the English War Office that two sets of Röntgen ray apparatus, it is reported, have been sent up the Nile to be used by the army surgeons in locating bullets and in determining the extent of bone fractures.

[1] From the "Electrical Engineer", London.

THE

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CONTENTS.

THE NEW YORK FIRE DEPARTMENT WIRING RULES.

During the month of June various meetings were held at Fire Department Headquarters in New York by the representatives of the various illuminating companies and the insurance interests in this city as well as the Contractors' Association and others, for the purpose of discussing with the representative of the Fire Department, Chief Inspector Henderson, the recent amendments to the Department Rules, and other proposed amendments. As this is the first time that these various interests have been invited to an open discussion of existing and proposed rules, relating to electrical equipment in this municipality, the proceedings have more than ordinary interest. That this movement on the part of the Fire Commissioners through their chief has resulted in a great amount of good, is true, without doubt. In looking over the rules as thus far amended, and which are now in operation, we note that they are radically different in a great many cases from the present New York Board rules, but they do not differ very much from the National Board rules, which have been adopted by all the underwriters, with the exception of the New York Board, under date of January, 1896.

It is now possible, under the new rules, to make installations of light and power plants in a thoroughly consistent manner, and various methods of construction are permitted in the way of running conductors from generators to switchboards, whereas, under the present New York Board rules, if they are lived up to, there is but one way in which conductors may be run from generator, etc., and that is, they "must be in plain sight, readily accessible, and wholly on non-combustible insulators." As far as this rule is concerned, it is notorious that the number of instances of its observance that can be cited, are so few that they are not worth mentioning. We are pleased to see, therefore, that the Fire Department has so quickly recognized the inconsistent attitude of the New York Board, and has made such broad changes as to permit of a great many classes of construction, all of which are as safe as can be asked for.

The old rule relating to the location and installation of motors, has been very intelligently revised, and the "8-inch" clause has been entirely stricken from the rule. Motors may now be directly mounted, and connected to various classes of work as may be desired, without being hampered with prohibitive and impossible requirements. If no changes in the rules had been made, other than this, the electrical interests in this district have certainly reason to be thankful that the Fire Department has so quickly shown its appreciation of the true condition of affairs as they have existed for years. Chief Henderson thus shows that he is fully alive to the necessity of removing the various hardships that have been placed in the way of progress, and it is plainly evident also, that it is the intention of the Fire Department, through its commissioners and officials, to endeavor to aid in all proper ways the illuminating companies and others engaged in the business.

Probably the most important rules that were up for discussion, were those in relation to the placing of "complete conduit installations." From the printed amended rules, that we have before us, we note, with considerable interest, that an interior conduit to be approved by the Fire Department "must have an approved insulating lining that will not soften when exposed to a temperature of 140 degrees Fahrenheit, and must be so placed that neither the lining of the conduit nor the insulation of the conductors will be injured by heat from steam or hot water pipes, or otherwise." We are also informed that the following conduits are permissible, namely: "Plain conduits equal to iron pipe of standard gauge may be used for conductors having lead or other approved armor." There is no ambiguity in this ruling of the Fire Department, and it would seem to us that it must meet the approval of all concerned, especially the insurance interests, inasmuch as the raising of the temperature limit to 140 degrees Fahrenheit, will certainly lead to the placing upon the market of a higher grade of conduit than

is now in use; and, if it is desired to use plain iron pipe, then those who care to can do so, by using lead-armored conductors, the same as have been used for subway work. This last ruling, if complied with, is certainly perfectly safe, from an insurance standpoint, although a rather expensive method of construction, and we doubt whether any one will employ it, as it is a well-known fact that it would be practically impossible to pull lead-armored conductors or cables through conduits, where more than two elbows are employed, without injury to the lead armor and possibly to the insulation itself.

We know that the National Board of Fire Underwriters is giving the question of conduit construction very careful consideration, and we see no possible hardship to arise or reason why all concerned should not wait until the meeting of the National Board experts before demanding such radical changes in any rules, that will permit the general adoption of plain iron conduit work. There is one thing certain to follow, it seems to us, namely, that if plain iron pipe work is ever permitted the wiremen and electrical contractors may say good-by to this class of construction work, as steam and gas fitters can place it in position far cheaper, and with far superior results, than any other class of men.

We also note that the embargo on series incandescent work for decorative purposes has been removed. All this class of work is now provided for under the new rules. The use of magnetic cut-out devices is recommended, but is not mandatory. The department, however, suggests that their use be extended as far as possible in connection with all equipments and that the subject be taken up at some future time.

After reading the new Department rules it seems to us that the electrical industries of New York and the insurance authorities as well have no cause to complain, but, on the contrary, should congratulate themselves that at last they have secured mutual recognition of their rights. If all concerned will now but continue to aid the Department, a standard set of rules, which will be properly and fairly interpreted and enforced upon all alike by those having legal authority, will be obtained, and the much-longed-for and desired end will have been reached.

OUR SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

HOWEVER much a technical journal may strive to keep its readers informed of the state of the art and science to which it is devoted, the volume of matter and the number of sources are so great that no single publication can hope to embrace it all within its own columns. The Electrical Engineer has in the past sought to obviate this difficulty by printing abstracts where lack of space prevented the complete publication of many important papers, but even by this short-cut method the limits of our space at times prevented reference to interesting articles. In order that our readers may therefore be kept thoroughly au courant with all the principal departments of electrical science and art, we have begun this week the publication of a "Synopsis of Current Electrical Literature," which we propose to publish regularly every week. The aim of this synopsis is to give the headings, name of author and the most salient feature brought out, or principal line of argument pursued, in the publication referred to. In order to facilitate the work of students and investigators who may be able to obtain some one journal more easily than another, all, or nearly all, publications will be quoted which publish the same article. Past experience in similar work has shown it to be advisable to employ as many sub-divisions or headings as possible, and as the work progresses others beside those in present use will be added. Since it is found difficult to determine under which heading to place a given article some cross references may be necessary, but these will be limited as much as possible. In making the synopsis one of the regular features of The Electrical Engineer we hope to make this journal still more valuable to its readers, and we believe that the Synopsis in connection with our Data Sheets will make The Electrical Engineer indispensable to every one interested in electrical work whatever the nature of that work may be. We may add that the Synopsis will be under the able editorship of Mr. Max Osterberg, whose previous work in this field has met with such marked success.

MUNICIPAL OWNERSHIP.

IN a recent issue we commented editorially at some length on the paper read by Mr. A. R. Foote, before the Street Lighting Convention at New Haven, and in which the fallacies of that cult were pretty well shown up. Since that publication we have received quite a number of requests for Mr. Foote's complete paper, and in compliance therewith publish this week a very extended abstract of it. This exhibition of interest on the part of our readers is strong evidence of the lively interest which this question still arouses in many quarters. We believe, however, that its intelligent discussion by competent authorities—backed by the results and experience in the cities that have tried the experiments, and whose accounts have been properly analyzed—has already begun to work a reaction, and we know of more than one contemplated city plant that has been abandoned. No stronger proof as to the inadvisability of municipalities engaging in public lighting could be cited than the cases of those cities that have tried the experiment and found it a failure, to their sorrow. We have always believed, and still believe, that a private corporation can furnish electric lighting cheaper than any municipality can perform the same service, for reasons which must be apparent to every one acquainted with the present status of American municipal politics. But when municipalities in addition to street lighting undertake to provide private consumers they introduce a feature contrary to every principle of equity, in that all are taxed to maintain a plant in order that a limited few may be served with a certain commodity at cost. The time has not yet come, unfortunately, when the electric light will displace gas, oil and candle-light in our cities, and until that time arrives every private consumer connected to a city plant will be served at the expense of his non-electricity-consuming neighbor. In these days of populistic sentiments one would imagine that this argument would suffice to determine the question in the minds of most reasoning voters, but much will have to be done yet to bring about the desired result.

SINGLE-PHASE ALTERNATING MOTORS.

TO produce a monophase alternating current motor which would be as easily adaptable to all kinds of work as is the shunt wound direct current motor has been a standing problem among electricians ever since alternating current central stations have been established, and to the lack of such a motor are due the invention and development of polyphase systems of distributions. We illustrate elsewhere in this issue a monophase alternating current machine recently designed by Mr. Langdon-Davies, of London, which appears, according to the report of Professor Silvanus P. Thompson, to be a decided advance over any previous machine of this type. The qualifications of a motor of any kind should include high efficiency, mechanical strength, large starting torque, constant speed regulation, large power factor and moderate starting current. In all these respects the Langdon-Davies motor seems to fulfill the conditions of an excellent machine, except in regard to the power factor, which, however, is capable of improvement. The production of a monophase alternating current motor of only three-fourths horse-power capacity, which can start under full load and which has an efficiency of from 90 to 95 per cent., according to the load, certainly, marks a very decided advance in the design of this class of motors.

THE PRICE OF RUBBER.

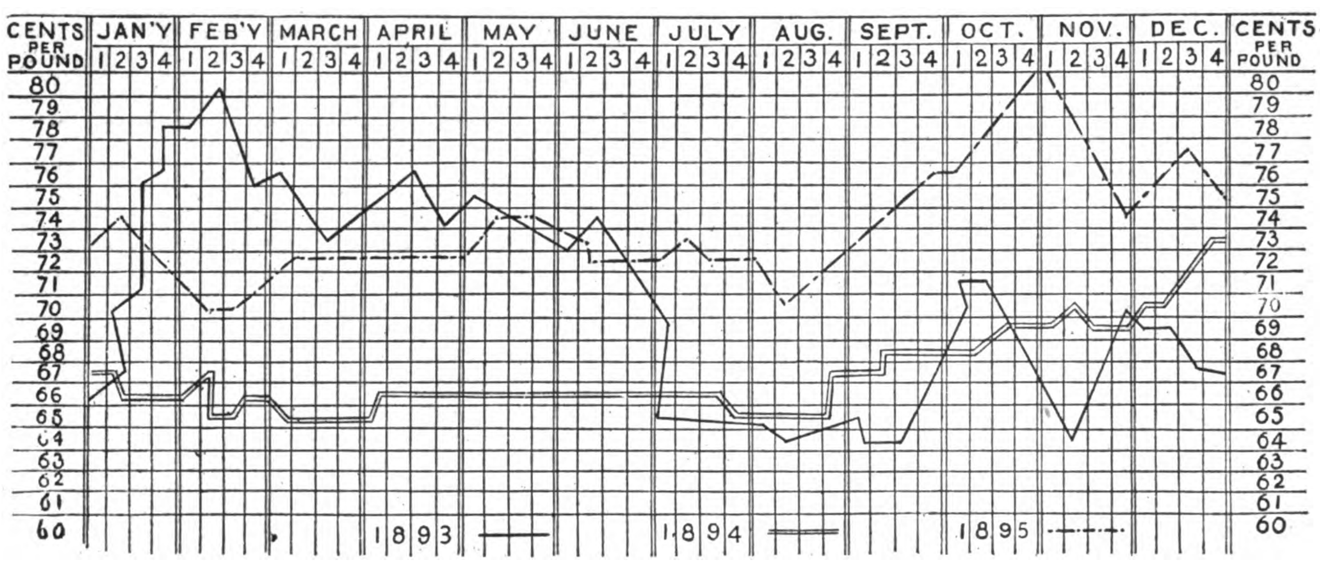
RUBBER enters so largely as a material in the electrical arts that its price must of necessity have its influence on the cost of apparatus and installations. Of late years we have heard much of the increasing scarcity of the rubber supply, and of the prospects of large increase in the price of rubber. Like many other statements of the same nature they have probably emanated from ill-informed sources. We have, therefore, thought it well to place before our readers an exact statement of the situation as regards the rubber market at the present time. As Mr. Hill shows on another page, there is little to be feared that the price of rubber will be increased materially in the future. On the contrary, the great demand made not only by the electrical arts, but numerous others within the last ten years or so, has stimulated enormously the production of rubber in the various parts of the world, and led to the opening of new fields of supply.

MISCELLANEOUS.

THE STATE OF THE INDIA RUBBER SUPPLY.

BY HAWTHORNE HILL.

WHILE the prevailing high prices of India rubber are for the moment of interest to the electrical industries, they need not cause alarm in this or any other line of manufacture. Especially should they not be regarded as indicating the beginning of the end of the supply of India rubber, as some writers have been too ready to infer. India rubber, like other commodities, always has been subject to fluctuations in the market, and the prices now asked and paid for it are to be attributed to the operation of the simple law of supply and demand, under which there may be a marked decline before the end of the year. After rubber had reached 97 cents in 1890 (for fine old Pará), it soon declined to 64; in 1891 it got up to 99 cents and fell again to 62, and so one might go on indefinitely. Doubtless the highest prices for rubber to be recorded in 1896 were paid for some small lots during June and July —90 cents per pound—and these figures were predicted weeks, if not months, in advance by experienced observers of the market. In an annexed diagram, illustrating the course of the crude rubber market during three years past, it will be seen that, although 1893 and 1895 showed frequent and marked fluctuations, prices were steady and at a low level during most of 1894. It is quite possible for similar conditions to exist in 1897, after the fluctuations of the present year, though it is to be hoped that they will not result from any such stagnation as our industries suffered two years ago.



QUOTATIONS FOR ISLAND SPOT FINE PARA.
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But it is not so much with fluctuations in prices that this article has to deal as with the extent of the sources of supply of India rubber, the known limits of which are constantly widening. It was the work of an intelligent man for Dr. John Forbes Royle, for instance, fifty years ago in England, to urge the importance of discovering or creating new sources of India rubber, against the time of the exhaustion of those known in his day. But then the extent of the rubber forests of South America was only faintly suspected, the presence of rubber in Africa was wholly unknown, and the commercial value of the rubber of Assam had not been demonstrated. Nowadays, a single voyage of exploration in remote Bolivia may bring to light a river before unknown even to the geographers of that country, lined with more rubber trees than were known in Royle's time to exist in the whole world. The fear of the exhaustion of rubber, however, did not die with Royle, some of whose phrases have served alarmist writers to this day. The British Government, following its marked success in transplanting the Chinchona trees from Peru to India, spent no small sum in trying to introduce the Pará rubber trees into the same country. But while the attempt has established the possibility of producing India rubber under cultivation, the practical sense of the age has prevented the development of rubber plantations, while new native supplies are annually being brought to light, quite as capitalists would be disinclined to invest in the creation of artificial coal fields.

The India rubber used in insulation work is of the grade known commercially as "Pará fine," named from the port at the mouth of the Amazon, which serves as a gateway to a watershed four times as extensive as the entire valley of the Nile. The Amazon stretches for 2,000 miles across Brazil, navigable for the whole distance by ocean steamers, and at short intervals receiving the waters of immense streams, each in turn navigable for hundreds of miles, and all lined with forests unbroken by man except where the undergrowth has been cleared away to open paths among the tall rubber trees. Beyond Brazil lies Peru, which also includes a lengthy section of the Amazon, and likewise extensive navigable affluents, with here and there the settlement of an enterprising rubber collector, with his force of native workers.

One of the Amazonian affluents, received in Brazilian territory—the river Madeira—forms the only water outlet for the Republic of Bolivia, with a larger area than any European State save Russia. Into the Madeira flow streams which form a great system of waterways, draining every corner of Bolivia, and these rivers, too, are lined with rubber trees. It was not until 1880 that the first shipment of rubber from Bolivia was made, but during the last fiscal year 1,600,000 pounds of the finest rubber in the world, and commanding the highest prices, were floated down her rivers, into the Amazon, and out upon the Atlantic at Pará. This rate of progress will not seem insignificant when it is remembered that, owing to dangerous cataracts in the Madeira, scattered along a distance of 230 miles, a cargo of Bolivian rubber is sometimes three months on the way to the seaboard, at a cost for transportation of 25 cents a pound. But even this remote rubber country is about to be made more accessible, with the aid of a concession for the ultimate building of a railway around the cataracts, in compliance with which a road for the transportation of rubber by cattle is already being opened.

The increase in the export of India rubber from Pará—including the total output from the Amazon basin—is thus shown by custom house records:

Year.	Pounds.
In 1840	938,058
In 1850	1,975,974
In 1860	5,627,226
In 1870	10,528,000
In 1880	18,889,000
In 1890	36,300,000
In 1895	46,363,000

Nowhere in rubber circles is this great increase regarded as indicating the extinction of the forests. In February last there was opened for traffic a submarine cable up the Amazon from Pará, covering a distance of 1,300 miles, including branches, built by the Siemenses and laid by their cable-ship "Faraday." Almost the whole basis of its expected revenues is the India rubber industry. Last month, at the annual meeting in Lon-

don of a company operating on the Amazon, it was reported that during the year nine steamboats had been added to their equipment, making the number now in their service over thirty. Their principal business is the conveying of India rubber down-stream and merchandise up-stream for exchange with the natives for their rubber. The State legislature at Pará adjourned lately after approving of fiscal estimates for the ensuing year, including expected receipts of export duties of 10,100,000 milreis,[1] mostly on India rubber—larger than the estimate for any preceding year. Likewise are the rubber export duties the principal reliance of Amazonas, the State adjoining Pará, while the exploitation of rubber is the hope of Bolivia and of Peru, particularly since the falling-off of the guano production of the latter country. These facts may have but slight bearing upon the electrical industry, but they should counteract any impression that India rubber is becoming scarce.

In every section that has been named the India rubber trees are more carefully sought than at any time in the past, by a greater number of rubber gatherers. Every year the zeal of explorers takes them into streams before unknown,[2] generally with the result that new rubber districts are found. Finally, merchants are constantly on the lookout for new opportunities for trading goods for India rubber, and so successfully that additional steamers are needed every year for their accommodation. All through the Amazon country an annual increase in the rubber output is looked for as confidently as the return of the seasons, and not the smallest basis of their hopes is the fact that the rubber trees are no longer ruthlessly destroyed, but the "paths" through the forests have attained a fixed commercial value, the same trees being tapped year after year.

It is true, that the consumption of India rubber has grown hand in hand with the production. Now and then, indeed, it has temporarily advanced more rapidly. But an increased demand is apt to be reflected in time in a greater number of rubber gatherers at work. Just now stocks of Para rubber are exceptionally low, although the production for the crop season ending June 30, 1896, was the largest on record. The authorized figures show:

	1893—94.	1894—95.	1895—96.
Receipts at Para, in tons	19,660	19,470	20,975
World's supply, June 30	3,250	2,260	1,835

Reference has been made thus far only to Para rubber, since this is the quality used for insulation work. But the increasing production, in various quarters of the globe, of inferior sorts available for other purposes, has been of great benefit to the industries requiring fine rubber, in serving to keep down the price of the latter. The rubber belt across tropical Africa is hardly less extensive than the great Amazon basin, and the progress of its rubber development has been scarcely less rapid. Thus Gold Coast Colony and Lagos, which shipped no India rubber fifteen years ago, had a combined output in 1895 exceeding 9,000,000 pounds. Nearly half as much more comes from Angola, which began to produce rubber only a few years ago. The important and growing production of rubber in Madagascar was the indirect cause of the recent French war with the Hovas. The wealth of rubber in the Congo Free State has been a prime incentive to the building of a railway around the falls in the Congo river. The first section of the road, 113 miles in extent, is now in operation, and Belgian concessionaires are playing for first place in the rubber trade on the Upper Congo when the completion of the road shall have overcome the present obstacles to navigation.

There has been no falling off in the production of India rubber in Central America, in the upper portions of South America, in East Africa, in Assam and Burmah, or in the East Indies. It may be that the limit has been reached in the production of gutta-percha, though the resources of Borneo have as yet been imperfectly explored. At any rate, outside the field of transoceanic cable laying, gutta-percha is less important for insulation work than India rubber, the first of the two materials to be used. Not only does the increasing production of the coarser rubbers tend to check advances in the price of finer sorts, but the astonishing development of reclaiming rubber from old shoes and the like serves a similar end. At least 25,000,000 pounds of reclaimed rubber are used annually by American manufactureres alone. These figures apply to genuine caoutchouc, and not to so-called "rubber substitutes," none of which has resulted satisfactorily in the United States.

As for the cultivation of India rubber, there is no reason why the trees should not grow as vigorously from seeds planted by man as from seeds scattered by the winds, or why the cultivated trees should not yield caoutchouc as freely as the native; in fact, experiments made in planting rubber in many lands would justify us in feeling independent in case the existing forests should become wholly exhausted before we have learned how to send electrical messages over sea without the aid of wires.

[1] One milreis = 54.6 cents at par of exchange.

[2] The major part of South America is today as much a *terra incognita*, and as little developed, as was the section of our own United States west of the Mississippi River fifty years ago.

THE TRANSFORMATION OF THE ENERGY OF CARBON INTO OTHER AVAILABLE FORMS.[1]

BY C. J. REED.

THE most serious defect in the galvanic battery, as a mechanism for transforming energy, lies in the fact that it can operate only by destroying its own mechanical integrity, to replace which is much more expensive than the mere materials of which it is built up. The ideal cell should consist of two indestructible, or reasonably permanent, conducting solids, in contact with a liquid electrolyte. The electrolyte should consist of two solutions, separated by a porous partition, through which one of the solutions flows. Each of the two solutions should contain a chemical reagent capable of combining with the other, on contact of the solutions, in an exothermic reaction. The transforming substance should be precipitated in its original state to be used over an indefinite number of times, and arrangements should be such that the exhausted electrolyte may continuously flow out of the cell and regenerated material flow in.

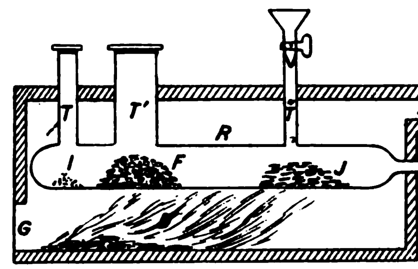


FIG. 1.

To illustrate this cyclic method of thermo-chemical transformation, we shall take as our transformer the two substances, sulphur and water; as fuel, carbon, and as oxidizing agent, atmospheric oxygen.

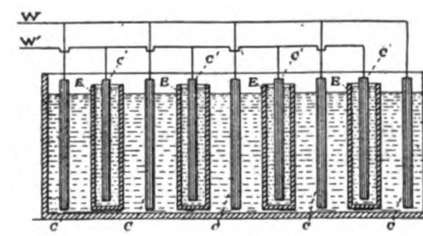


FIG. 2.

The first step in the process is the combustion of sulphur in the air, with production of sulphur dioxide, SO_2, and the evolution of 71,000 units of heat, as represented in the equation: $S + O_2 = SO_2 + 71{,}000$. The SO_2 formed by this reaction is passed through water, which absorbs it and forms the oxidizing electrolytic solution. Some sulphuric acid may be added to increase the conductivity.

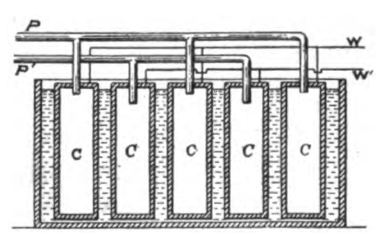


FIG. 3.

The heat developed by the combustion of the sulphur is applied to a retort, R, shown in Fig. 1. Carbon is admitted to this retort at F, through the tube, T'; sulphur is admitted at I through the tube, T; and water is allowed to drop upon a pile of broken stones at J. The sulphur is burned at D with air supplied through the opening, G. The SO_2 passes out at S.

[1] Abstract of paper read before the Franklin Institute, May 26, 1896.

The heat from the sulphur burning at D heats the carbon, F, to a dull-red heat. The sulphur, I, is vaporized, and, passing over the heated carbon, forms carbon disulphide. The carbon contains 97,000 and the S_2 142,000 units of molecular potential referred to oxygen and the CS_2 formed contains 258,000. The reaction, therefore, absorbs 19,000 external heat units.

The CS_2 next comes in contact with the steam and hot bricks at J, where double decomposition occurs with absorption of 14,000 external heat units and the formation of H_2S and CO_2, which pass out at A. We have now expended the total energy of 310,000 units, of which 270,000 have been transferred into H_2S and 38,000 lost in the furnace heating.

The next operation is to bring the SO_2 and H_2S together so that the electrical energy will be evolved and the transforming substances, sulphur and water will be regenerated.

An apparatus in which this final reaction may take place is shown in Figs. 2 and 3. In Fig. 2 the carbon electrodes, C, are in contact with one solution, either the SO_2 or the H_2S, while the carbon electrodes, C', are in contact with the other solution. The two solutions are separated by the porous cups, E. The solution within the cups should be at a higher level than that outside.

The SO_2 and H_2S may be delivered in the gaseous state under pressure to the apparatus shown in Fig. 3. One gas is delivered through the tubes, P, to the interior of the hollow carbon electrodes, C, and the other through the tubes, P', to the hollow carbon electrodes, C', both being immersed in dilute sulphuric acid. The electric circuit is completed by the wires, W and W'. The pressure should be sufficient to force the gases through the pores of the carbon electrodes into the electrolyte in which they dissolve. The regenerated sulphur is precipitated as a white powder, and may be separated by filtration or settling.

The three atoms of sulphur regenerated are exactly equal to the three atoms used, and hence they may be eliminated, leaving, as the net transaction, one atom of carbon expended and 59,000 units transformed into electrical energy, or a maximum efficiency,

$$E = \frac{59,000}{97,000} = 61 \text{ per cent.}$$

The actual attainment of 61 per cent. efficiency would require, however, that the final or galvanic step in the process should take place without loss. While this is a theoretical possibility, it cannot be expected in practice. The theoretical electromotive force of the cell would be

$$\frac{59,000}{4 \times 23,260} = 0.63 \text{ volt.}$$

The highest voltage I have ever obtained on closed circuit is .36 volt, corresponding to an efficiency of 35 per cent.

INFLUENCE OF CARBON ON PERMEABILITY.

In his paper read before the Institution of Civil Engineers on "Magnetic Data of Iron and Steel," Mr. H. F. Parshall remarked that a study of the results of magnetic tests and their comparison with those of the chemical analysis showed a more or less intimate relationship according to the degree with which the modifying physical conditions might be controlled. In general, a greater degree of purity was an indication of high permeability, but as the different qualities of iron and steel merged into each other by insensible degrees, owing to variations in the processes of manufacture, chemical analysis might be taken only as an approximate indication of the magnetic properties. Carbon was the most important element entering into the composition of commercial iron, and within the limits that chemical analysis might serve as an indication of the physical structure, the permeability was inversely as the amount of carbon present. The limitation as to the state of physical structure was greatly affected by the state of the carbon, that is, whether free or combined; in cast iron, as well as in steel, the effect of graphite was second to that of the carbide, commonly known as fixed or combined carbon. Beyond a certain degree of purity, as in wrought iron and carbon steels, the treatment as to annealing and tempering became of first importance. The magnetic properties of some of the alloys of iron, nickel, or manganese were such as to show that the physical structure was the ultimate determining factor. The hysteresis loss was, in general, inversely as the degree of purity, but in comparatively pure irons it was determined principally by its treatment as to annealing, heating, and mechanical straining.

MAGNETIC FATIGUE.

BY ED. C. DE SEGUNDO, ASSOC. M. INST. E. E.

THE recent papers on "Magnetic Testing of Iron and Steel," by Prof. Ewing, and "Magnetic Data of Iron and Steel," by Mr. H. F. Parshall, read at the Institution of Civil Engineers, deal with the subject of magnetism from a commercial point of view in a most useful manner, in a manner which appeals very strongly to the engineering mind.

The reading of these papers at the Institution of Civil Engineers immediately after the most able James Forrest lecture delivered by Dr. Kennedy, cannot fail to be considered peculiarly à propos, inasmuch as the labors of these gentlemen in collecting, classifying and tabulating, so many experimental results obtained in exactly the spirit and in the directions which were referred to in Dr. Kennedy's lecture as of paramount importance to the advance of engineering science, may be considered an undesigned tribute to the truth and justice of the conclusions arrived at by Dr. Kennedy, who may justly be said to be the pioneer of exact engineering experimental science.

A very important matter, from a practical point of view, was dealt with during the discussion by Dr. Fleming and Prof. Ayrton, namely, the peculiar characteristic possessed by iron to deteriorate magnetically, if one might use the expression, under the influence of long-continued reversals of magnetism such as occur, for instance, in the core of a transformer. Every one is fully alive to the very great importance of transformation, particularly in dealing with electric light or power transmission problems involving supply in a scattered area or at points a very long distance away from the source of energy, and therefore this effect, which perhaps might be called "Magnetic Fatigue," is one which, it is easily recognized, would have a great influence indeed upon the economical aspect of the methods adopted in the solution of the above-suggested problems.

The analogy between the experiments of Wöhler on the influence of continued variations of stress upon the ultimate strength of various metals and the magnetic "sticktion" in the iron of a transformer core after some years of service, is interesting.

Wöhler showed that variations of stress, of which the higher limit was only a little in excess of that corresponding to a well-defined elastic limit in the materials under experiment, brought about fracture or rupture if only repeated long enough, but that if the variations, though perhaps changing from tension to compression, were well within the elastic limit, the material would suffer no degradation even after many millions of alternations of stress.

In the case of a transformer core, however, the effect of the deterioration is not similar; the material becomes more sluggish in its response to the inductive influence, it loses magnetic elasticity, and its magnetic inertia, so to speak, is increased, but it is analogous in that by long-continued reversals of magnetism, even as by long-continued reversals of mechanical stress, the material becomes less efficient for the purposes for which it was intended.

After all there is nothing surprising in this increase of hysteresis loss with time. Clearly the natural condition of iron is unmagnetized, and it is common experience that any interference with nature is not indulged in with impunity.

It will be remembered how Wöhler's results when first published completely modified our preconceived ideas and principles underlying the design of such structures, as, from the nature of the load they are intended to bear, may be subjected to rapid alternations of stress, either between the limits of low and high positive value, or between negative and positive limits. The line of experimental research suggested by Wöhler has by no means yet been followed to its extreme limit, not for the lack of enthusiastic and willing workers, but because of necessity such experiments must spread over a very considerable period of time, and although we know enough at present of the fatigue of metals to prevent a serious blunder in design, it cannot be safely said that experiments have gone so far as even to be within measurable distance of exhausting the field of research.

Analogy does not constitute logic nor yet legitimate argument, but it cannot be denied that analogy is extremely fascinating, in that it is so highly suggestive. In this particular connection we have two analogous phenomena which appear to arise from analogous causes. They are certainly brought about by analogous treatment. May we not, then, hazard the view that the analogy may be continued so far as to suggest to us that there is a limit to the value of "B," corresponding to the limit of elasticity in materials of construction between which alternations of induction, however rapid and however long continued, would not bring about the molecular change, or whatever it may be in the structure of the material, which

causes this disinclination on the part of the material to respond to the influence of magnetic lines of force?

It would certainly seem that Prof. Ayrton's terse remarks in the discussion on the papers above alluded to were pregnant with a meaning which perhaps did not appeal to the whole of the audience who heard him, and it may be said, with much justification, that further time and energy spent in the determination of the hysteresis loss in various different samples of iron are certainly of little value in arriving at the best material for transformer cores, as long as the laws governing the time value of "Magnetic Fatigue" are not known.

It is by no means unlikely that the more permeable specimens may be the very first to show a marked magnetic fatigue.

It would not be difficult to design and carry out a series of systematic experiments designed to reveal the existence of such laws (if they do exist), and with the facilities at our disposal in the numerous efficiently equipped electric laboratories which now exist in many parts of the country, it would be an interesting and instructive task, the results of which would be of untold value to the engineer.—London "Electrical Review."

MUNICIPAL ADVANTAGES.—HOW TO OBTAIN THEM.—I.[1]

THE author began by giving a number of extracts from his book, entitled "Discussion of Economic Principles Involved in the Law of Incorporated Companies Operating Under Municipal Franchises (1892)," and continued as follows:

When a municipality makes an investment in a plant for carrying on a business, it must first lay a tax to procure the funds. Funds for such purposes are generally raised by the sale of bonds; therefore, the tax is for the annual payment of the interest on the bonds and a small per cent. of the principal. If the service is performed without charge to its users, as in the case of street-cleaning, its entire cost must be paid by taxation. If, as in the case of the manufacture and distribution of gas or electricity, for the purpose of producing light, heat and power for the public and private use, a charge is made. If it is high enough to produce a profit, the amount of the profit enhances the cost of services to its consumers, for the benefit of those taxpayers who are non-users, many of whom are non-residents. If the charge fails to produce a profit, the amount of the loss, which must be paid by taxation, reduces the cost of the service to its users, and benefits them at the expense of those taxpayers who are non-users.

He would be a rash man who would undertake to prove that funds obtained by taxation are expended as economically by those in control of municipal affairs as funds acquired by the processes of private industries and business, are expended by those who have been obliged so to earn them. The reason municipal credit is good is not because municipal business is managed equally well with the best industrial corporations, but because a municipal debt is a first mortgage on all property within the municipal limits. The aggregate property is of such enormous value that the security is ample, and the power of taxation is so absolute that payment is certain.

Political corporate ownership and management does not utilize the natural force of self-interest legitimately. Industrial corporate ownership and management does. The users of the services rendered under such management gain the benefit of the economic value or self-interest. The cost of services to users, furnished at the cost of production by political corporations, all factors of cost being duly considered, is greater than the necessary charges for the same services rendered by industrial corporations. No person can be found who has closely observed how all public work is done, who will hesitate for a moment to affirm that private management, in comparison with public management, is at least 20 per cent. more efficient, saving, and economical in every way. This margin is the direct product of the legitimate utilization of the natural force of self-interest and indicates its economic value. This value is wasted when a profit-producing industry is transformed into a non-profit producing industry, by the legal enactments that transfer its ownership and management from an industrial to a political corporation. Such waste is like a leak in a dam constructed to utilize water power. It is an absolute loss of energy.

The utilization of the economic value of self-interest will create sufficient margin for profit to induce industrial corporations to undertake to supply every public service, if these corporations are granted the same conditions in their franchise as those given by the State, without question, to political corporations. In view of this fact, it is unnecessary for any municipality to bond itself for such purposes, or to assume the responsibility of the management of such industry.

Profit-producing industries are avenues to industrial independence and economic freedom for all who are engaged in them. For wage-workers, more than any others, the self-interest of the individual, the moral interest of society, and the group interest of the municipality, state and nation, demand that all avenues of industrial independence and economic freedom shall be kept open.

By the aid of corporate services, the conditions of life have been improved for every person. While they are not as good or as low in cost to their users as they would be if rendered in accordance with the economic law of labor and property, the advantages secured by them enable every person to enjoy more comfort, greater freedom, a higher degree of intelligence, and to acquire more wealth than was ever before possible. These services are more than self-sustaining.

They are assisting every person to make a profit for himself. They are the means by which the poorest members of society secure the services of the most intelligent and wealthy. They are tools of highest efficiency for the uses of industry, commerce and social life.

Instead of dividing the energies and resources of a municipality by competition between corporations and citizens, they should be united and used in a competition between municipalities for greatest excellence, and industrial, commercial, and social advantages. Substitute competition between municipalities for competition between citizens. The standard of excellence will be the best service at the lowest cost to their users, and the lowest municipal taxation.

That State which first succeeds in intelligently changing its system, or want of system of organizing or controlling municipal political and industrial corporations, by adopting a system in conformity with the outlines herein given, will soonest establish the conditions that will induce the greatest degree of prosperity and well-being for its municipalities and their inhabitants. So conditioned and so controlled, municipal industrial monopolies will be recognized as the friends and servants of the people, and will render the best services of which they are capable at the lowest obtainable cost to users.

A PROPHECY BEING FULFILLED.

Permit me to turn back to a statement made in a book I published in 1889 (2) under the title of "Economic Value of Electric Light and Power." It is as follows:

"Not many years compass before the progress of events will satisfy cities that have taken the ill-advised action of buying an electric lighting plant that, instead of gaining an advantage, they have created an obstruction to the proper development of an electrical service. To secure the full advantage of that service, they will, sooner or later, sell their plants to private companies, who will operate them under contract in connection with the private light and power service."

In a work under the title of "Municipal Ownership—Its Fallacy," published by M. J. Francisco, in 1895, it is stated that the following municipalities have seen their mistake and sold their lighting plants: Greenville, S. C.; Carrolton, Ga.; Stockton, Kan.; Lyons, Ia.; Marceline, Mo.; Marietta, O.; Michigan City, Ind.; Portland, Ore.; Tipton, Ia.; Titusville, Pa.; Moline, Ill.

The Council of Madison (Ind.) voted to sell the municipal lighting plant October 17, 1895, and many others are on the verge of doing so.

The most notable instance of the failure of a municipality to operate an industrial undertaking advantageously is furnished by the city of Cincinnati. On June 15, 1896, the sinking fund trustees of Cincinnati accepted a bid of $19,000,000 for the sale of the Cincinnati Southern Railway.

GOOD CITY GOVERNMENT.

I have recently examined a volume of the "Proceedings of the Second National Conference for Good City Government," held at Minneapolis, December, 1894, and of the "First Annual Meeting of the National Municipal League for Good City Government," held at Cleveland, May, 1895. The good intentions of those engaged in this movement cannot be doubted; that they will effect many reforms of high public value is well assured.

It is easy to see, however, that a long and difficult task lies before them to prepare municipal governments to undertake any enlargement of their functions. The reports made at these conventions from nearly all large cities agree that public business is not conducted with scrupulous care and honesty. Human nature is very much alike the world over. In Chicago a grand jury declares that the public offices are "honeycombed with corruption" and "many officials steeped in crime."

In St. Louis, the committee investigating the work on the partially completed city hall "continue fresh evidences of gross fraud in the construction, and the huge pile of granite and iron

[1] Abstract of a paper read before the Street Lighting Convention, New Haven, June 17.

will, it is said, have to be reconstructed." France has recently been stirred deeply by scandals connecting the Chamber of Deputies with the Southern French Railway Syndicate. In Tokio, Japan, the municipal council has been dissolved; three of the waterworks standing committee have been arrested, increasing the number of prisoners to thirty-seven in the great waterworks scandal of that city. Thirty-two cities in Massachusetts and five in Rhode Island inaugurated new governments on the 1st day of January, 1896. Nearly all of the mayors in their inaugural addresses urged that a check be placed upon municipal expenditures. Josiah Quincy, Mayor of Boston, said: "I shall at once ask the legislature to consider the postponed constitutional limitations of the indebtedness of cities, and the subject of securing such changes in the tax system of the commonwealth as are necessary for promoting the industrial development of the city." And just now the press of New York City is urging that "the streets ought to be repaved in the best possible manner before the end of Mayor Strong's term, in order that the people may see that intelligence is more desirable than ignorance in the conduct of public affairs, and be spared the horrors of a return to barbarism."

WRONG IN PRINCIPLE.

I have tried to show that municipal ownership is wrong in principle. If it is, it is foredoomed to failure in practice. I have had too much experience in dealing with statistics to permit myself to deal largely with data that I cannot verify. Every person who honestly undertakes an intelligent discussion of this subject feels the fatal lack of accurate data. None should be so inaccurate as to suppose, without a careful personal examination into all local conditions, that the results given for one town can be used as a standard for any other town.

One of the most notable examples of municipal ownership of a gas plant is found in Philadelphia. If the accounts of that venture were accurately written up, they would show it had been unprofitable in comparison with a service rendered by a private corporation.

The most notable example of the municipal ownership of an electric light plant is furnished by the city of Chicago. A careful study of this plant was made by Mr. Fred DeLand, of Chicago, the publisher of 'Electrical Engineering," last September. He found the cost (excluding allowance for taxes and insurance) for operating the municipal plant to be $153.48 per arc lamp per year. Unreliable quotations of the cost of operating this plant have damaged the electric lighting business of this country many times the value of the plant. It is a well-known fact that a private company is ready any day to contract to furnish lights at a less cost than the city can produce them from its own plant.

The most recent champion for the honor of demonstrating the economy of municipal ownership of an electric lighting plant is the city of Detroit. In 1893 legislation was secured permitting the city to bond itself for $600,000, for the construction of a municipal plant, that was to produce arc lights at $84 per year. The plant had been in full operation but three months when the city papers came out with startling headlines, "Dollars in Pocket," "Saving so far shown by the city lighting plant," "Average cost per lamp per month is only $7.20." Another paper makes the statement "CUT IN HALF." "Street arc lights costing a little more than $85."

The last contract made by the city of Detroit with a private company was at the rate of $137.80 per lamp per year. This was previous to the panic of 1893. At the time the city of Detroit took this action I stated that the act of the Legislature granting authority to issue bonds and erect the plant had been obtained on insufficient evidence; that the plant would cost more than $600,000, and that the lamps would cost more than $84 per year to operate. The plant cost about $650,000. Mr. Dow, the electrician in charge, states in a letter published in the Detroit "Free Press" that "the bond issue was $600,000, and the remainder of the capital was raised by direct tax." In a letter published in The Electrical Engineer for January 29, 1896, he states "operating cost, plus maintenance, interest, sinking fund to bonds, and a 5 per cent. theoretical depreciation is practically $100 per arc per annum, is substantially true." It will be observed that this "substantially true" statement allows but 5 per cent. for depreciation and makes no allowance for the taxes a private company owning the plant would have to pay. This certainly is a remarkable statement made by the city electrician, called out by criticisms of the flaming newspaper accounts of the great saving effected by the city plant, by those who know how to read between the lines.

The Detroit municipal plant has been running about nine months. Already there is a demand for an additional $200,000 for extensions and the "substantially true" cost of operating the lamps is far above the $84 which was the promised performance.

I will now place myself on record once more: If the accounts of cost are fully and correctly stated at the close of the first, or any other year of the life of this plant, it will be found that the cost per lamp is greater than the contract price now in force in New Haven (Conn.) and many other cities being served by private companies under term contracts. This being true, where is the vaunted saving effected by municipal ownership and management?

Mr. Dow makes one statement in his letter to The Electrical Engineer, which demands special attention. He admits that the steam plant and towers belonging to the Detroit municipal plant will require renewing within twenty years, and that the electrical apparatus and other construction will need to be replaced in less time, but he says: "I want the depreciation cared for in the same way in the public case as in the private. To add 5 or 10 or 15 per cent. of the investment on to municipal annual costs is not the way to estimate a 5 or 10 or 15 per cent. depreciation; because, in the municipal plan, the 5 per cent. stays in the hands of the taxpayers and is invested and reinvested and multiplied many times in the active business of each individual long before the twenty years expire. And because, conversely, the stockholders in the private company either reinvest their surplus over dividends (which is their depreciation fund) right in the company's business, or else divide it and use each man's share in his own affairs. The latter is the exact equivalent of the method in municipal lighting. The surplus need not be collected from the customers and divided among the stockholders because customers and stockholders are, man and man and interest for interest, the same persons."

This is most subtle sophistry. I regret to state that it has found approval by one Professor of Economics, Edward W. Bemis. It is here clearly shown that the eagerness of political managers to make prestige for effecting a large saving by the operation of a municipal plant leads then into the same error frequently committed by managers of private coporations in their eagerness to make large dividends.

The depreciation of a plant by use is as much a part of the cost of operation as is the coal bill or payroll, and should be fully included in every statement of cost. Any other course will lead to inevitable diaster.

In private corporation management, the omitting of this item of cost and a consequent showing of an abnormally large profit invariably produces two results.

First. It causes the city council and private consumers to make a common cause of a demand for reductions in price, and those restless spirits who seek the public good through every excuse they can find for "downing a monopoly" to agitate the cause of municipal ownership, the enormous (?) saving they show, as is now the case in Detroit, being entirely due to the omission of a part of the items of cost.

Second. Twenty years hence the municipal taxpayers and the corporation shareholders will not be "man for man, and interest for interest, the same persons" that occupy these relations to the undertakings to-day. If the cost of depreciation is not collected and set aside month by month and year by year, from the beginning, future taxpayers ana shareholders will be robbed for the benefit of those now in position to be benefited by the robbery.

Pursuing the course Mr. Dow so unequivocally recommends, the inevitable result will be that, year by year, the cost per lamp will creep up as the charges for repairs and renewal of apparatus and construction grow heavier and heavier, until it will pass the point at which there can be any pretense that the municipality is making a saving by owning and operating its electric lighting plant. This will be the condition when the reserve fund, now left in the pockets of the people with such a flourish of economic achievement, will be called up from the pockets of the taxpayers to pay for renewing the plant. With the wisdom that can come to many only through the teachings of a sad experience, they will then reconsider the doings of misguided enthusiasts of to-day, and long before the expiration of twenty years, the estimated life of the plant, they will sell it out to a private corporation and save money by obtaining their public lighting by contract from a private monopoly. There is nothing new about this. The process is perfectly familiar to those who have observed the course of events in all undertakings of a similar character. It is simply perpetuating in political management one of the worst features of private corporate speculation.

When a private corporation is financiered in this way, the first result is to send the price of stock way above par on account of the large profits shown. Those who understand correct economic principles sell out on top of the market, and those who do not, buy. When half the life o fthe plant is run, and the burden of expenses is increasing rapidly, there is a new set of shareholders who find the value of their shares depreciating, caused by the decrease of profits, and in many instances the entire disappearance of dividends. Then come assessments for the reconstruction of the plant, the appointment of a receiver,

the reorganization of the company on a basis scaling down the old capitalization of the company, to repeat the experience unless it falls into the hands of those who know enough to include the cost of depreciation in their operating expenses, and, knowing what it costs to operate a plant, to make a charge for their services sufficient to pay a legitimate profit. Every such experience adds to the number of those who, because they do not know why the result was brought about, are loud in their talk about bad management, corruption, and the freezing-out of shareholders.

OBITUARY.

SIR JOHN PENDER.

WE regret to announce the death of Sir John Pender which took place on July 7 at his residence at Footscray, Kent, England. The immediate cause of death was paralysis, but Sir John had been an invalid for more than a year and had indeed only just recovered partially from a long and severe illness. The stroke which attacked him a few days ago and eventually proved fatal was the third he had experienced during the past six months. Even then, such was his vitality, that it was believed and hoped he would linger somewhat longer than he actually did. He had recently resigned his seat in Parliament for the Wick Burghs and withdrawn from all but the most urgent business affairs.

Sir John Pender was the only son of the late Mr. James Pender, of the Vale of Levin, Dumbartonshire. Born in 1815, he had attained his eighty-second year and, although death is naturally to be expected at such an age, his disappearance will be widely recognized as an occasion for more than ordinary regret. He has laid his generation under obligations of a very special nature, for had not his generosity and stoutheartedness come to the rescue the development of ocean telegraphy would have been delayed for many years subsequent to the breaking of the Atlantic Cable in 1865.

Sir John's early history gave promise of great practical ability and an intelligent spirit of enterprise, though at first it had nothing to do with the application of electricity. Well educated and early put forward into business life he became the General Manager of a factory in Glasgow when little more than twenty years of age and was afterwards known as a successful merchant, both in Glasgow and in Manchester. In the latter city he rendered valuable service during the period of the cotton famine both by assisting in the organization of relief and by his own beneficence, keeping his workmen employed during the paralysis of the cotton industry.

Before that period Sir John Pender had begun to interest himself in submarine telegraphy, and he became one of three hundred and forty-five persons who each contributed £1,000 towards the laying of the original Atlantic cable in 1857, an undertaking of which the inception was due to the late Cyrus W. Field. The attempt to establish direct telegraphic communication between England and the United States was subject to repeated failures for a period of eight years when the cable of 1865 parted while it was being paid out from the capacious hold of the Great Eastern. The case seemed desperate. The Atlantic Company, of which Sir John Pender was a Director, suffered financial ruin. The public would subscribe no further capital, and the government would render no help. But Sir John still believed that success was attainable, and there were a few others whose confidence was also maintained. A large sum of money had already been thrown into the sea and it required robust faith to resist such discouragement.

But the faith was forthcoming, and when the Gutta Percha Company wanted a guarantee of a quarter of a million before undertaking to make the cable for a renewed enterprise, Sir John at once offered to become personally responsible for that amount. The guarantee was accepted and the Telegraph Construction and Maintenance Company was formed by the union of the Gutta Percha Company with Glass Elliot & Co., Sir John Pender, (then Mr. Pender) being the Chairman. Success of a twofold nature ensued, the new cable being satisfactorily laid, while the one which the Great Eastern had lost was recovered.

A striking allusion to the crisis at which Sir John Pender so happily intervened was made by the late Lord Derby eight years ago when Lady Pender was publicly presented with her husband's portrait. Speaking of the Atlantic cable his Lordship said: "It is not too much to affirm that but for Sir John Pender and a few others of whom he was chief, that enterprise would have collapsed and at best a long delay would have occurred before investors consented to risk their capital in such a speculation again." Admitting that the enterprise would have been accomplished at some date or other, Lord Derby argued that in such a case the loss of time represented by even one generation would have meant almost incalculable loss, material loss to England. In his further remarks it was shown how Sir John had made this particular victory the starting point of other enterprises scarcely less important and in their aggregate perhaps of even greater consequence than the laying of the Atlantic cable. Thus Sir John became Chairman of the company which laid the first line to India and was mainly instrumental in establishing communication with Australia and China. It was also due in a great measure to his exertions that South Africa became connected telegraphically with England. Energetically supported by the present Marquis of Tweeddale and the late Sir James Anderson an amalgamation of enterprises was formed by which oceanic telegraphy obtained a worldwide extension.

Possessing great discernment of character and keen commercial sagacity, Sir John Pender was highly qualified as an organizer and an administrator. He knew the value of scientific research and for that reason invoked the aid of such authorities as Lord Kelvin, Dr. Alex. Muirhead, Mr. Herbert Taylor and others in those matters which related to the working of telegraph cables. The staff whom he gathered round him were eminently qualified for their duties and the personnel of his companies throughout the world proved worthy of the positions so occupied. The extent of the work which had thus to be controlled is shown by the fact that the capital of the submarine telegraph companies over which Sir John presided was not much less than £15,000,000, while the aggregate length of the cables exceeded 73,000 nautical miles, bringing in a revenue last year of £2,153,000, the reserve funds standing very nearly at £3,000,000.

Not limiting his attention to submarine operations the same indefatigable worker and organizer was Chairman of the Metropolitan Elec. Supply Co. of London, which maintained last year upwards of a quarter of a million of lights and takes a foremost place among such undertakings. In respect to the telegraph cable companies of which Sir John was Chairman, it is to be observed that they have not merely lived, but grown, thus affording practical evidence of the ability with which they have been conducted, their value in the share market being a fair test of their soundness and success.

On such a man it was natural that honors should descend, though of these he had no excess. His public services were unquestionable and in recognition of these Queen Victoria in 1888 made him a Knight Commander of the Order of St. Michael and St. George, followed in 1892 by advancement to a grand cross of the same order. In 1870 the Prince of Wales was present at Sir John Pender's house in Arlington street to celebrate the completion of the connection, by ocean cables, of England with India. Twenty-four years later, when Sir James Anderson had passed away, Sir John presided at the Imperial Institute at the silver Jubilee of the formation of the company for the establishment of submarine telegraphy to the East and far East, and on this occasion he was again honored with the presence of the Prince of Wales. Some time ago when visiting Constantinople Sir John received from the Sultan the Grand Cordon of the Medjidieh, the honor being the highest that could be granted to an alien. Other rulers indicated their appreciation of Sir John Pender's labors by similar marks of distinction. Among the orders conferred were those of the French Legion of Honor, the Italian Knight Grand Cordon of the Crown, the Portuguese Order of the Rose and the Greek Cross of Commander of the Royal Order of the Savior. At quite a recent date the French government conferred upon Sir John its highest colonial order, that of Commander de l'Ordre Royal du Dragon d'Annam. Among the incidents of Sir John Pender's home career special reference must be made to his long connection with the House of Commons.

ELECTRIC PLANTS NOT EXEMPT FROM TAXATION AS MANUFACTORIES, IN MARYLAND.

An important decision was handed down in the U. S. Circuit Court last week in the injunction suit of the Frederick (Md.) Electric Light and Power Company vs. the Corporation of Frederick, to restrain City Register L. H. Nixdorff from levying upon the plant of the company for the payment of taxes alleged to be overdue. The opinion filed dismissing the application for an injunction on the ground that electricity is not a manufactured article and that electric light plants do not manufacture it, but merely distribute it, was written by Judge Lynch and concurred in by Chief Judge McSherry. This is the first time the question has been brought into the courts in the State of Maryland, and the decision is considered a very important one.

The electric light company will be compelled to pay about $500 back taxes on their plant. They claimed exemption from taxation on the ground that their concern was a manufacturing plant, and that the corporation of Frederick had exempted all manufacturing plants locating in the city from taxation for a period of five years.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Biographical:

KELVIN JUBILEE CELEBRATION.—Complete account with the address by Lord Kelvin.—"The Electrical Engineer," July 1, 1896.

FRANKLIN LEONARD POPE.—Biography in "Electrical Age," July 4, 1896.

Central Stations:

BRIGHTON CENTRAL STATION EXTENSION.—An illustration of the buildings in section and elevation.—London "Electrical Engineer," June 26, 1896.

HARTLEPOOL ELECTRIC TRAMWAYS.—The line has a total length of 2½ miles. Boilers, which are in duplicate are fed by an electrically driven three-throw feed pump. Two direct coupled dynamos and Willans engines with a speed of 450 revolutions are used, with a normal output of 120 amperes at 500 volts. Detailed description is given in London "Electrical Engineer," June 26, 1896.

Dynamos and Motors:

LANGDON-DAVIES SELF-STARTING, MONO-PHASE INDUCTION MOTOR. Detailed description with illustrations and curves.—London "Elect. Review," June 26, 1896. London "Electrician," June 26, 1896.

SAYERS' DYNAMO.—By M. Aliamet. Description with illustrations on the design of a hermetically closed dynamo.—"L'Electricien," June 27, 1896.

ON THE SEAT OF ELECTRODYNAMIC FORCE IN IRONCLAD ARMATURES.—By E. J. Houston and A. E. Kennelly.—It is shown in this paper that in the particular type of armature used, more than 98 per cent. of the entire torque was exerted on the iron, less than 2 per cent. being produced by the conductors.—"Elect. World," July 4, 1896.

Electro-Chemistry:

THERMO-ELECTRIC REACTIONS AND CURRENTS BETWEEN METALS IN FUSED SALTS.—By Thomas Andrews. This paper contains the results of extended experimental inquiries by the author on the subject of currents between metals in fused salts.—"Industries and Iron," June 26, 1896.

ELECTRICITY DIRECT FROM CARBON.—By Dr. Alfred Coehn. Read before the Berlin Elektrot. Verein. Author found that he could produce a solution of carbon; that from such a solution carbon may be separated as a cation and that an element may be formed of which carbon is the soluble electrode.—The Electrical Engineer, July 1, 1896.

Lighting:

COAST AND LIGHTHOUSE ILLUMINATION IN FRANCE.—By C. S. du Riche Preller. A description of the electric lighting, flash light, of the alternating current machinery used, of the annual cost of French coast lighting and also of incandescent gas light.—London "Engineering," June 26, 1896.

ELECTRIC LIGHTING AND RAILROADING IN THE UNITED STATES.—A table showing the number of hours of service per day, number of watt hours produced, quantity of fuel consumed, and the number of watt hours per pound of coal in 82 central stations.—"Revue Industrielle," June 27, 1896.

CONNECTING LIGHTHOUSES AND LIGHTSHIPS WITH THE SHORE.—Abstract of the fourth report submitted by the Royal Commission.—The Electrical Engineer, July 1, 1896.

HIGH VOLTAGE LAMPS IN ALTERNATING CURRENT PRACTICE.—By H. W. Couzens. Abstract of a paper read before the Municipal Electrical Association, in which author points out advantages of the alternating current system.—"The Electrical World," July 4, 1896.

Magnetism:

MAGNETIC FATIGUE.—By Ed. C. de Segundo. Author briefly reviews the lectures and works of Ewing, Parshall, Kennedy and Wöhler and points out the importance of determining whether "magnetic fatigue" follows a certain law, and if so, what that law is.—London "Electrical Review," June 26, 1896.—The Electrical Engineer, July 15, 1896.

Measurements:

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES.—By J. A. Fleming, M. A., F. R. S. A discourse delivered at the Royal Institution, June 5, 1896.—A great many details of experiments made with curves illustrating the results.—London "Electrical Engineer," June 26, 1896. The Electrical Engineer, July 8, 1896.

ON THE CONSTRUCTION OF A CAPILLARY ELECTROMETER. By R. Vigouroux. A short illustrated description of a newly constructed instrument.—"L'Electricien," June 27, 1896.

A NEW LORENZ APPARATUS.—A complete description of a new set of apparatus for the determination of resistance in absolute measure.—London "Electrician," June 26, 1896.

ELECTRICAL RESISTANCE OF ALLOYS.—By Lord Rayleigh. Author suggests the possibility of a thermo-electric effect existing between the substances composing the alloy, thus introducing apparent resistance, which in reality are counter e. m. f.'s. He finds a formula for this false resistance and applies it to an alloy of copper and iron.—London "Electrician," June 26, 1896.

MEASUREMENT OF VERY LARGE AND VERY SMALL ALTERNATING CURRENTS.—By Mr. Campbell. Paper read before the Physical Society, June 12, 1896. Author advocates the use of air core transformers for measuring voltages and currents which are either above or below the range of the instruments available. This method is briefly described and an abstract of the accompanying discussion follows.—London "Electrician," June 26, 1896.

Mechanical:

SIMPLE ELECTRIC PLOW.—Illustrated description of a plow designed by Israel Hogeland.—"Western Electrician," July 4, 1896.

ELECTRIC ORGAN AT THE STATE INDUSTRIAL SCHOOL, ROCHESTER.—This is an electric organ action; a storage battery is used in connection with it.—"Western Electrician," July 4, 1896.

Miscellaneous:

COST OF ELECTRICITY SUPPLY.—By Arthur Wright, borough electrical engineer, Brighton.—Author points out that no manufacturing undertaking can be considered to trade on a sound commercial basis, unless it has ascertained with some degree of accuracy the cost of supplying the commodity it produces; he shows how charges vary and then describes a modification of the Hopkinson method applied to the accounts of the Brighton Corporation.—London, "The Engineer," June 26, 1896. London "Electrical Review," June 26, 1896. "Industries and Iron," June 26, 1896.

Railways:

ELECTRIC TRACTION FOR TRAMWAYS.—By J. Allen Baker.—Author presents a number of statistics and records of progress made in various European cities; he also refers at some length to the successful systems used in the United States. An itemized table shows a total mileage of electric and other mechanical traction on the Continent of Europe to have been 515 miles on January 1, and 351 miles under construction at that time.—London "Electrical Engineer," June 26, 1896.

ELECTRIC PASSENGER CARS.—Some photographs showing the exterior and interior of vestibuled motor cars.—"Railroad Gazette," June 26, 1896.

CONTROLLING APPARATUS FOR STREET RAILWAYS. —Description of a controlling apparatus which is put up at the office of the Superintendent who can see at any time the position of any car, the number of stops or any irregularity taking place in the system.—"Die Elektrizität," June 27, 1896.

INTERNATIONAL PERMANENT STREET RAILROAD ASSOCIATION.—A detailed account of all the questions which are to be discussed at the ninth general meeting to be held at Stockholm in August next.—"Die Elektrizität," June 26, 1896.

ORGANIZATION OF THE SYSTEM OF TRAFFIC AND THE TECHNICAL CONDITIONS FOR ELECTRIC STREET RAILWAYS IN BERLIN. By Dr. M. Kallmann.—Lecture delivered before the Elektrotechn. Verein April 28, 1896. An interesting paper giving an insight into the demand which the German public makes on the car companies.—"Die Elektrizität," June 26, 1896.

CARS MADE OF ALUMINUM.—A short notice stating that the Directors of the French Government railroads have ordered some cars built in which aluminum is being used wherever copper and iron were formerly employed, except at the axles, wheels and couplings.—"Die Elektrizität," June 26, 1896.

THIRD RAIL ON THE NANTASKET BEACH ROAD.—Of special interest is an illustrated description of the third rail and a view of the contact shoe.—The Electrical Engineer, July 1, 1896.

ELMIRA STREET RAILWAYS.—A detailed account with many illustrations and diagrams.—"Electrical World," July 4, 1896.

OUTLOOK FOR THE ELECTRIC RAILWAY. By F. C. Armstrong.—Paper read before the Canadian Electrical Association, Toronto, Ont., June 18, 1896.—A general review of the progress made during the last few years.—"Western Electrician," July 4, 1896. "Electrical Review," July 1, 1896.

Roentgen Rays:

ROENTGEN RADIATIONS. By T. C. Porter.—Any arrangement by which a charge on the outside of the tube behind the cathode would be subject to intermittent removal greatly increases the fluorescence and photographic action of the discharge, as well as prevents the "fatigue" of the tube. Abstracted from a letter to "Nature" in London "Electrical Engineer," June 26, 1896.

FLUORESCENCE VISIBLE AND INVISIBLE.—An abstract of a discussion in the Société Française de Physique participated in by Mr. Guillaume, who pointed out that the theoretical difficulties which have been believed to block the way to an efficient fluorescence lamp do not really exist.—London "Electrical Engineer," June 26, 1896.

POLARIZATION. By S. P. Thompson.—A communication before the Physical Society, June 12, 1896. A large number of crystals have been tested under the Röntgen ray, but no polarization was detected.—London "Electrician," June 26, 1896.

BLEYER PHOTO-FLUOROSCOPE. By J. Mount Bleyer, M. D.—Apparatus for photographing the fluorescent screen.—The Electrical Engineer, July 1, 1896.

Telegraphy, Telephony, etc.:

STATISTICS OF DISTURBANCES ON LOW VOLT CIRCUITS DUE TO HIGH PRESSURE LINES. By Dr. Strecker. Presented before the Elektrotechn. Verein at Berlin. Report of 76 distinct cases between 1891—1896. Telephone lines were affected more than telegraph lines. Detailed account of the principal cases in "Die Elektrizität," June 26, 1896.

HOME TELEPHONE COMPANY'S SYSTEM, MOBILE, ALA.—An installation which differs widely from the ordinary Bell company's system. Line and station connections, calling apparatus, combined receiver and transmitter, switchboard annunciator lamp and magnet, testing plugs, etc., are described in detail and many illustrations furnished.—The Electrical Engineer, July 1, 1896.

EDUCATING OPERATORS IN THE HANDLING OF THE SWITCHBOARD. By W. F. Packard.—Paper read before the Association of Railway Telegraph Superintendents. Author points out the importance of operators being able to make quick repairs.—"Electrical Review," July 1, 1896.

COMBINED ELECTRIC LIGHTING AND TRACTION PLANT. By John Hesketh and John H. Rider. Paper read before the Municipal Electrical Association. The object of the paper is to show that lighting and railway plants should and can advantageously be combined.—London, "The Engineer," June 26, 1896. "Industries and Iron," June 26, 1896.

Transmission of Power:

EXTENSIONS TO OUTLYING DISTRICTS. By A. H. Gibbings. Paper read before the Convention of the Municipal Electrical Association. Author dealt with the cost of extending supply into the suburbs and houses scattered over a large area. He gives useful tables of rental of houses, shops, etc., in one particular street with the gas bills for each particular rental.—Short abstract in London "The Engineer," June 26, 1896.

NIAGARA FALLS. By T. C. Martin. Abstract of lecture delivered before the Royal Institution.—Appeared in London "Electrical Engineer," June 26, 1896.

ELECTRICAL TRANSMISSION IN SPAIN.—Power is obtained from a river with no natural fall. Dam and canal were built, the latter being 2 kilometres in length and 5 square metres in cross section. Effective height is 96 feet and minimum quantity of water is 6,000 cubic feet per minute. Turbines of 150 h. p., when running at 375 revolutions per minute, are coupled direct to the alternators. Shafts of turbines are horizontal. Alternators are single-phase type, 110 kilowatt, 6,500 volts, 50 periods per second.—London "Electrical Review," June 26, 1896.

ALTERNATING AND DIRECT HIGH VOLTAGE SUPPLY.—A summary of the remarks of the speakers at the Convention of the Municipal Electrical Association, with some additional considerations, in order to put the subject forward in an impartial manner.—London "Electrical Review," June 26, 1896.

THIRTY-FIVE MILE ELECTRIC POWER TRANSMISSION AT FRESNO, CAL.—7,000 horse-power are developed at the water wheels. Three-phase generators are used of 350 kilowatt capacity each. Detailed account in The Electrical Engineer, July 1, 1896.

BALTIC—TAFTVILLE TRANSMISSION PLANT. By H. E. Raymond.—This plant is situated in Connecticut and has two turbines of 800 horse-power and one of 300 horse-power capacity. Two 250 kilowatt, 2,500 volt, three-phase generators are used.—Details of plant in "Electrical World," July 4, 1896.

POWER TRANSMISSION BY POLYPHASE ELECTROMOTIVE FORCES. By Geo. White-Fraser.—Paper read before the Canadian Electrical Association. Begun in "Electrical Review," July 1, 1896, and to be continued in subsequent issue.

Wiring:

CONTROL BY MUNICIPAL AUTHORITIES OF CONSUMING DEVICES AND THE WIRING CONNECTING THEM TO THE MAIN. By C. H. Wordingham.—Paper read before the Institute of American Electrical Engineers. gives several of the principal rules and regulations of the Board of Trade and suggests the advisability of having an engineer employed who would for a small fee consult with anybody wishing to install a plant; or that the corporation itself should employ a staff of workmen to carry out wiring.—London, "The Engineer," June 26, 1896. London "Electrician," June 26, 1896.

EFFECT OF TEMPERATURE ON INSULATING MATERIAL. By G. F. Sevey, A. Monell and C. L. Perry. Paper read before the American Institute of Electrical Engineers. Deals with the effect of certain insulating materials, such as paper, cloth, oiled paper, oiled cloth. Tests were made and the conclusions drawn.—London "Electrical Review," June 26, 1896. "Electrical Age," July 4, 1896. The Electrical Engineer, May 13, 1896.

EFFECT OF TEMPERATURE ON INSULATING MATERIALS. By Chas. F. Scott. Communicated to A. I. E. E. Illustration of apparatus used, description of methods and conclusions on tests made.—The Electrical Engineer, July 1, 1896.

ELECTRIC LIGHT WIRING AND TESTING. By Newton Harrison, E. E.—One of the lesson leaves of the American School of Electricity. Enumeration of the possible troubles that may arise and methods for prevention and cure.—"Electrical Age," July 4, 1896.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 7, 1896.

Alarms and Signals:—

COMBINED ANNUNCIATOR AND FIRE ALARM. M. Garl, Akron, O., 563,269. Filed Sept. 27, 1894.
Details of construction.

APPARATUS FOR SELECTIVE SIGNAL SYSTEMS. F. R. McBerty, Downer's Grove, Ill., 563,294. Filed Aug. 23, 1895.
The act of making connection with the line automatically determines the excitement of the signal to which it is desired to respond.

ELECTRIC POLICE SIGNAL SYSTEM. C. E. Scribner, Chicago, Ill., 563,324. Filed May 14, 1894.
Means for preventing telephonic appliances from interfering with the transmission of telegraphic signals.

ELECTRIC SIGNALING APPARATUS. F. W. Turner, Newton, and W. M. Chapman, Needham, Mass., 563,336 Filed April 18, 1891.
Adapted for police-signal purposes.

INDIVIDUAL CALLING APPARATUS. W. W. Alexander, Kansas City, Mo., 563,352. Filed April 8, 1893.
Details of construction.

ELECTRICAL SIGNALING APPARATUS. S. S. Bogart, Schraalenburg, N. J., 563,442. Filed Oct. 16, 1894.
Comprises an answer-back provided with a winding and checking mechanism.

AUTOMATIC FIRE ALARM. J. W. Frost, New York, 563,474. Filed Feb. 18, 1888.
The combination with a signaling mechanism, and an electromagnet normally controlling the same, of a closed circuit through the said magnet, the said closed circuit being looped between the magnet and the battery on each side, cross-connections, normally open, connecting opposite sides of each loop, and mechanically operated switches adapted to close said cross-connections.

IN AND OUT INDICATOR. J. P. Milbourne, Monton, England, 563,501. Filed Dec. 26, 1895.
Details of construction.

AUTOMATIC REPEATER. J. W. Frost, New York, 563,586. Filed Aug. 16, 1892.
An automatic repeater which shall be so combined with devices at the transmitting station as to accomplish automatically what has heretofore been done by an operator.

Storage Batteries :—

STORAGE BATTERY. W. J. Still, Toronto, Canada, 563,428. Filed Sept. 18, 1894.

A series of conducting-plates, all of the same polarity, interposed active material, elastic means for binding the plates together at right angles to their adjacent faces.

Conductors, Conduits, and Insulators :—

CABLE HANGER. A. S. Diehl, Chicago, Ill., 563,263. Filed Jan. 21, 1896.
A strap adapted to encircle the cable and carrying upon its upper end a hook.
MEANS FOR INSULATING ELECTRIC CONDUCTORS. T. Guilleaume, Mulheim-on-the-Rhine, Germany, 563,273. Filed March 19, 1895.
A naked conductor inclosed in and twisted angular tube of non-conducting material.
ELECTRIC CABLE. T. Guilleaume, Mulheim-on-the-Rhine, Germany, 563,274. Filed Nov. 2, 1895.
Employs grated or ground vegetable fiber or bark surrounding the conductor and inclosed by a braiding or tubular covering.
FLEXIBLE MICA INSULATING SHEET. C. W. Ferferson, Schenectady, N. Y., 563,379. Filed March 16, 1895.
Consists of layers of fibrous and mica sheets and gutta-percha tissue between any and every two of said layers.
INSULATING SUPPORT FOR RAILS OF ELECTRIC RAILWAYS. P. Haley, Chicago, Ill., 563,482. Filed March 9, 1896.
The combination with a suitably supported insulating block adapted to support a rail and formed with sockets in its lateral faces, of clamps having hooked portions adapted to grasp the flange of said rail, and lugs extending into the sockets in the insulating block and suitable means for connecting the clamps.
ELECTRICAL CONNECTOR. B. L. Toquet, Westport, Conn., 563,695. Filed May 13, 1896.
Rail-bond.
ELECTRICAL INSULATING SHEET. C. W. Ferferson, Schenectady, N. Y., 563,716. Filed March 16, 1895.
Consists of layers of asbestos and mica, and adhesive gutta-percha tissue between any and every two of said layers.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. C. P. Steinmetz, Schenectady, N. Y., 563,426. Filed Jan. 30, 1895.
For alternate current systems.

Dynamos and Motors :—

BRUSH FOR ARC DYNAMOS. H. H. Wait, Chicago, Ill., 563,337. Filed Aug. 20, 1895.
The combination with a main brush of an independently fed auxiliary brush situated at the tip of the main brush.
COMPOUND-WOUND MULTIPHASE GENERATOR. C. P. Steinmetz, Schenectady, N. Y., 563,427. Filed March 19, 1896.
Two separate armatures connected in quadrature and energized by different fields, independent circuits extending from each armature and independent compounding and regulating means in each of the circuits.
ELECTRIC MOTOR. E. J. Berg, Schenectady, N. Y., 563,440. Filed Oct. 8, 1895.
Means of indicating synchronism of an alternating current motor; one or more incandescent lamps connected across the field terminals.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. C. E. Scribner, Chicago, Ill., 563,315. Filed Jan. 2, 1893.
Two sets of carbons are provided, so that when one set is consumed the other set may be automatically brought into circuit.
INCANDESCENT LAMP. C. E. Scribner, Chicago, Ill., 563,319. Filed July 20, 1891.
The combination with an exhausted bulb of glass of a film of carbon deposited upon the inner surface of the bulb and leading in wires sealed into the bulb, making electrical connection with the film.
INCANDESCENT LAMP. C. E. Scribner, Chicago, Ill., 563,321. Filed May 9, 1893.
Means for hermetically sealing the bulb in such manner that the bulb and the filament may be separated for purposes of renewal.
PROCESS OF BUILDING UP CARBON FILAMENTS. F. S. Smith, Pittsburg, Pa., 563,329. Filed Aug. 29, 1892.
Consists in heating the filament in a rare medium, together with anthroquinone.

Miscellaneous:—

LIGHTNING ARRESTER AND AUTOMATIC FUSE BLOCK. T. L. Carleton, New Orleans, La., 563,257. Filed Feb. 28, 1894.
A conducting bar and a non-conducting bar, a series of contact wires connecting them, a spring-controlled contact arm to successively engage the contact wires and a brush making sliding contact with the contact arm.
APPARATUS FOR HEATING THERMOPILES. E. N. Dickerson, New York, 563,262. Filed March 8, 1892.
A device for heating thermopiles by a heated gas index pressure.
ELECTRICAL PRODUCTION OF CHEMICAL REACTIONS. W. Lobach, Chicago, Ill., 563,288. Filed Nov. 30, 1894.
Process of bleaching oils.
ELECTRICALLY CONTROLLED BOAT STEERING APPARATUS. C. E. Ongley, New York, 563,304. Filed Dec. 20, 1892.
Means for connecting the cable and rudder and a magnet in a suitable circuit normally holding said means out of engagement with the rudder.
CONTACT POINT FOR ELECTRICAL INSTRUMENTS. C. E. Scribner, Chicago, Ill., 563,326. Filed Aug. 17, 1895.
Details of construction.
COMBINED PESSARY AND WOMB-BATTERY. M. E. Keller, Fort Worth, Tex., 563,387. Filed July 31, 1895.
Details of construction.
MAGNETO-ELECTRIC MACHINE. P. J. Crouse and E. W. Millgate, Utica, N. Y., 563,453. Filed Sept. 7, 1895.
Details of construction.
THERMOSTAT AND CIRCUIT THEREFOR. J. W. Frost, New York, 563,475. Filed March 28, 1890.
A concavo-convex disc, confined at its edges, two or more contact pieces co-operating therewith, the said disc and the said contact pieces having an adjustable relation to each other.
PROCESS OF MANUFACTURING WHITE LEAD. A. B. Browne, Cambridge, and E. D. Chapin, Natick, Mass., 563,553. Filed Dec. 20, 1894.
The manufacture of white lead by the separation of an electrolyte with a solvent of lead and an alkaline hydrate, and then treating it into a solvent of lead and an alkaline hydrate, and then treating it by electrolysis.
PROCESS OF MANUFACTURING OXIDS OF LEAD. A. B. Browne, Cambridge, and E. D. Chapin, Natick, Mass., 563,554. Filed Jan. 28, 1895.
Similar to above.
MANUFACTURE OF WHITE LEAD. A. B. Browne, Boston, Mass., 563,555. Filed April 3, 1896.
MAGNETO-ELECTRIC GENERATOR. A. G. Leonard, New York, 563,599. Filed Aug. 10, 1894.
May be operated either by hand or by a passing train to generate electric currents at intervals.
APPARATUS FOR THREADING CONDUITS OR PIPES. T. J. Cope, Philadelphia, Pa., 563,360. Filed March 4, 1895.
Comprises a head, a tailpiece, a carrier, rods common to said head and tailpiece, and sleeves mounted on said rods and adapted to serve as stops for said carrier.
ELECTRIC HEATER. T. Grutting, St. Paul, Minn., 563,715. Filed Sept. 9, 1893.
The heating conductor's conductivity increases with increase of temperature, and a controlling conductor whose conductivity decreases with increase of temperature in series therewith.
PROCESS OF PRODUCING CALCIUM COMPOUNDS. T. L. Willson, New York, 563,527. Filed March 16, 1893.
Consists in mingling lime with a liquid reducing agent, such as liquid hydrocarbon, drying the said mixture and subjecting it to the heat of an electric furnace.
PROCESS OF MANUFACTURING HYDROCARBON GAS. T. L. Willson, Brooklyn, N. Y., 563,528. Filed Feb. 28, 1894.
Consists in treating calcium oxid in the presence of carbonaceous matter in an electric furnace, forming a calcium carbide and combining water with the said calcium carbide.
BOTTLE FILLER. W. H. Fahrney, Chicago, Ill., 563,464. Filed March 11, 1895.
Means for holding open the valve between the bottle and the supply until a predetermined point and then closing such valve.

Railways and Appliances:—

ELECTRIC RAILWAY. H. Brandenberg, Chicago, Ill., 563,254. Filed April 16, 1895.
Conduit system.
ELECTRIC RAILWAY. E. Lachmann, Hamburg, Germany, 563,282. Filed June 30, 1894.
An upper air-tight channel room with a slot in the side wall and a water trough above the channel cover.
AUTOMATIC BLOCK SIGNAL AND ANTI-COLLISION APPLIANCE FOR RAILWAYS. H. W. Harris, deceased, R. J. Harris, administrator, Raleigh, N. C., 563,374. Filed May 14, 1895.
An electromagnetic device located upon the locomotive connected with the brake system, and which is in electrical connection with the conductor along the trackway.
SPEED INDICATOR. T. O. Bateman, Fort Worth, Tex., 563,544. Filed July 20, 1895.
Especially designed for use on trolley cars.
TROLLEY WIRE FROG. M. F. Bean, Springfield, Mass., 563,446. Filed Jan. 29, 1896.
Details of construction.
TROLLEY CATCHER. C. F. Wilson, Brooklyn, N. Y., 563,531. Filed March 6, 1896.
Comprises a winding mechanism for receiving the trolley operating rope.

Regulation:

METHOD OF AUTOMATIC CURRENT REGULATION OF DYNAMO ELECTRIC MACHINES, 563,290. Filed Aug. 6, 1894.
Consists in maintaining two portions of the field at a uniform magnetic moment.
MECHANICAL MOVEMENT. E. A. Sperry, Cleveland, O., 563,424. Filed Nov. 11, 1893.
A single lever operates to control a motor.
REVERSING CONTROLLER FOR ELECTRIC MOTORS. A. C. Dinkey, Munhall, Pa., 563,575. Filed Sept. 3, 1895.
A rheostat having arc-shaped main contact plates through which the current always passes in the same direction, separated series of resistances, each series having two sets of contact blocks, and an arm arranged to move over said arc-shaped plates and said contact blocks in opposite directions and thereby reverse the current.
RHEOSTAT FOR ELECTRIC MOTORS. H. W. Leonard, New York, 563,600. Filed June 21, 1895.
Embodies a final protective step of high resistance so as to prevent the net effective electromotive force in the circuit from sending a destructive current through the rheostat.

Switches, Cut-Outs etc. :—

CIRCUIT ESTABLISHING CUT-OUT. A. L. Tucker and F. H. Loveridge, Chicago, Ill., 563,335. Filed Aug. 8, 1895.
Details of construction.
ELECTRIC SWITCH. C. G. Perkins, Hartford, Conn., 563,407. Filed April 1, 1896.
Embodies a rotary lettered disc, the lettering of which registers with a perforation through the cap after each turn of the handle spindle.
ELECTRICAL SELECTOR. S. S. Bogart, Schraalenburg, N. J., 563,443. Filed Jan. 5, 1895.
Details of construction.

Telegraphs :—

CABLE TERMINAL ATTACHMENT. A. T. Welles, Chicago, Ill., 563,342. Filed March 3, 1896.
The combination with connecting blocks of a casing of insulating material having plates above and below said blocks, an insulating compound filling the space remaining within said case, and means for connecting the safety fuses and the distributing wires, respectively, with said blocks.

Telephones:—

MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES. O. A. Bell, New York, 563,250. Filed May 19, 1892.
Circuits and mechanism whereby the individual annunciator of a line shall be automatically reset.
BRIDGING BELLS. C. E. Scribner, Chicago, Ill., 563,318. Filed March 6, 1891.
Details of construction.
MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EX-

CHANGES. C. E. Scribner, Chicago, Ill., 563,320. Filed March 5, 1892.
The combination with the core of an electromagnet of the magnetizing helix thereof, an additional normally-open-circuited coil encircling the same core and means for closing the circuit of said additional coil in short circuit.
TELEPHONE CIRCUIT. C. E. Scribner, Chicago, Ill., 563,322. Filed June 16, 1893.
Means for preventing "side tone" produced in a telephone receiver by vibrations of its own microphone.
TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 563,323. Filed Nov. 13, 1893.
The combination with a plug circuit of a repeating coil having its helices included in series in one conductor of the circuit, and a key adapted to disconnect the repeating coil and close circuit directly in place thereof.
SYSTEM OF CURRENT DISTRIBUTION FOR SUBSTATION TELEPHONES. C. E. Scribner, Chicago, Ill., 563,325. Filed Feb. 28, 1895.
The telephone transmitters at the substations are supplied with current from a common source located at a central point.
TELEPHONE EXCHANGE SWITCHBOARD. C. E. Scribner and E. P. Warner, Chicago, Ill., 563,327. Filed Feb. 7, 1890.
A switchboard table provided with separately removable plug sockets arranged along the longitudinal center of the board and the spring-jack placed on opposite sides of said sockets.
SPRING-JACK FOR TELEPHONE SWITCHBOARDS. H. B. Thayer, New York, 563,333. Filed July 5, 1895.
Details of construction.
TELEPHONE TRANSMITTER. W. A. Moore, Brooklyn, N. Y., 563,395. Filed March 25, 1896.
Employs an oil-silk diaphragm.
TELEPHONE SYSTEM. J. Piel, New York, 563,614. Filed April 13, 1896.
Details of construction.
TELEPHONE SIGNALING CIRCUIT. J. S. Stone, Boston, Mass., 563,692. Filed March 18, 1896.
Provides means whereby the bell armature is made free to respond to the signaling current.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE "H. W. J." ELECTRIC CAR HEATER.

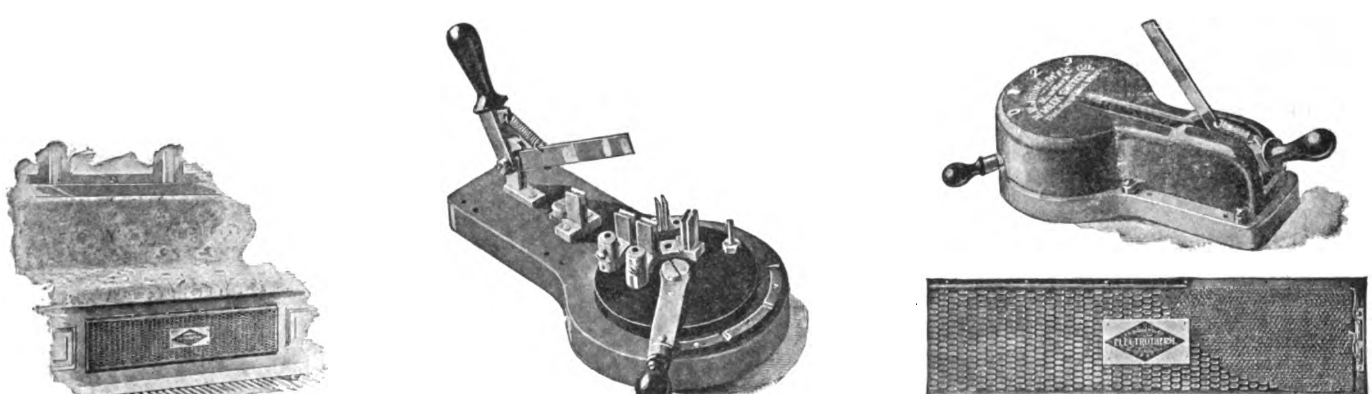
ONE of the causes of the short life and unreliability of the average electric heater is the ultimate breaking of the wire. This may be due to crystallization, as a result of prolonged vibration caused by the jarring of the car; to the movement of the wire over its supports as it elongates and contracts when heated and cooled; or to oxidation, which will be manifested when the wire is overheated, and as a result of the condensation of moisture when cold, and by standing idle for any length of time. Much trouble has also been caused by the difficulty of preventing short circuits between the bare uninsulated wires, and of keeping the wires securely attached to their insulating supports.

A novel departure in the arrangement of the resistance wires and insulation has been made in the "H. W. J.," or "Electrotherm," car heater, and the above difficulties have been practically overcome. The resistance wires, after being wound with asbestos cord, are woven into a mat or cloth with an asbestos warp. The wires are thus effectually insulated from each other, and the liability of short circuits obviated; the movements of the wires resulting from expansion and contraction are confined within their asbestos envelope, which, to prevent oxidation by moisture, is thoroughly waterproofed with a special insulating compound baked in. The mat thus prepared is attached to a backing of asbestos millboard, and confined in an ornamental perforated steel casing, as illustrated in the engraving. By this method of constructing an electric heater, a very large heated surface is exposed for both radiation and convection, and it becomes possible to obtain the most satisfactory results with a long length of wire heated by the current to a comparatively low temperature. The liability of "burn-outs" is thus practically obviated, and the durability of the heater is measurably increased.

The heaters are attached to the faces of the panels beneath the seats the full length of the car on both sides. Attachment is made by screws, and no cutting or other injury to the car is necessary. As an exceedingly large heating surface is provided, the car is heated with an evenly distributed temperature by heaters, none of which is overheated so as to cause discomfort to, or burn the clothing of passengers.

The regulating switch illustrated provides for these degrees of temperature represented by the consumption of about 3, 6, and 9 amperes. This method of electrically heating the cars has proved its simplicity and economy during the past season, and it is expected that many "H. W. J." heaters will be found in operation during the coming winter.

The "H. W. J." heaters are manufactured by the H. W. Johns Manufacturing Company. The Electrotherm, which is a flexible heating pad made for home and hospital use, in a manner similar to the car heaters, is also being furnished by them to meet the demand for the most modern and convenient means of generating and applying heat by electricity.



THE "H. W. J." ELECTRIC CAR HEATERS AND REGULATING SWITCH.

WILLYOUNG INDUCTION COILS WITH ADJUSTABLE CONDENSERS.

Mr. James G. Biddle, Drexel Building, Philadelphia, is meeting with marked success in introducing the new Willyoung induction coils with adjustable condensers. This apparatus is built upon correct, improved, scientific lines and is fully equal in grade of workmanship and efficiency of results to the best types, which have been made heretofore only in England and France. When properly handled each coil is guaranteed to produce a continuous discharge of the rated spark length without breakdown or other injury.

The adjustable condenser is a feature of great value, for it enables the discharge to be varied through wide ranges and adapts the coil to vacuum tubes of different degrees of exhaustion. The advantage of this condenser over the form previously used is precisely the same as that of an adjustable field rheostat over one of fixed value. While the Willyoung coils are superior for any work that requires such apparatus, the greatest demand at present is naturally for X-ray coils, and particular attention is devoted to this department. Each detail of construction is watched with utmost care, and the following remarks from a prominent purchaser indicate the manner in which the apparatus operates.

Mr. W. W. Griscom, president of the Electro-Dynamic Company, writes under date of June 26: "I am highly pleased by the behavior of the coil which you last sent me. I do not think it could be possible for a coil to work any better. It gives a splendid stream of sparks at six inches and occasionally a spark would strike across a distance of eight inches. I congratulate you on the success of the various experiments, and beg to thank you for your efforts in getting me the best possible coil, and for your kindness in adding the little practical improvements."

Messrs. Willyoung & Co. make a specialty of constructing coils of large size, and are also prepared to fill orders quite promptly. Mr. Biddle will be glad to furnish price lists and further particulars upon request.

CEILING FANS FOR ELEVATOR CARS.

A new and very novel application of an electric fan to the ceilings of the elevator cars of the Taylor Building, at 39 Cort-

landt street, has been made by the Globe Ironclad Motor Company which have offices in the same building.

The rotation is horizontal, thus throwing the air downward and affording a delightful breeze to heated passengers. The motor is so constructed as to be dustproof, rendering it particularly lasting for this purpose. Mr. Williams has certainly conferred a great favor on perspiring humanity by his ingenious device.

J. G. BRILL COMPANY'S PIVOTAL TRUCK.

THE truck which we illustrate herewith is built by the J. G. Brill Company, of Philadelphia, so that its wheels are independent of each other in their vertical motion, while the truck frame itself can rise or fall at the ends, or move sidewise bodily without imparting any of these movements to the body of the car. The general design of this truck is shown in the illustration, Fig. 1. The frame is a forging, the wheel pieces being of a form somewhat like that which is so effective in locomotive practice. To a bar of ample stiffness jaws are forged at the proper points, and from the outermost jaw at each end extension pieces are carried to which T-iron end pieces are bolted. On the wheel piece between the jaws and as close to them as may be practicable lugs are forged for carrying the spring links. Upon the inside of these wheel pieces, which are made of steel castings for electric service, brackets are cast to take the angle iron transoms. The strains upon the truck frame for a given weight of car and load are much less than in the ordinary construction. The swing links come close to the pedestals, relieving the wheel pieces from a large part of the strain which comes upon them when the load is carried by the transoms. Fig. 2 shows the motion of the truck with the new and with the old style of construction. The old style is shown on the right, and that of the new truck on the left.

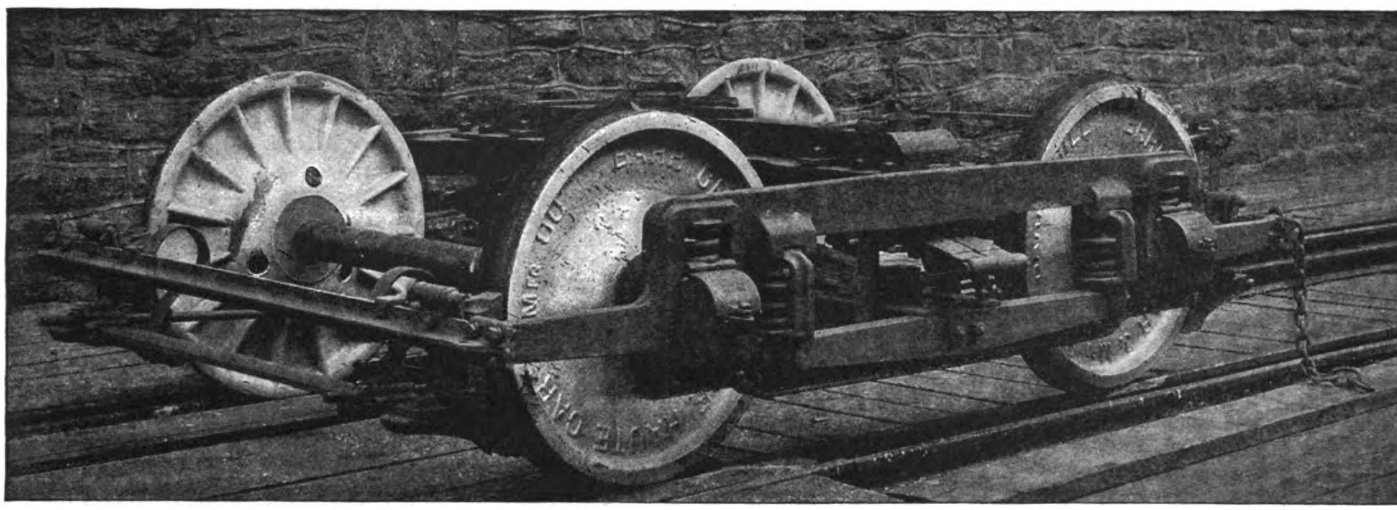


Fig. 1.—The Brill American Passenger Pivotal Truck.

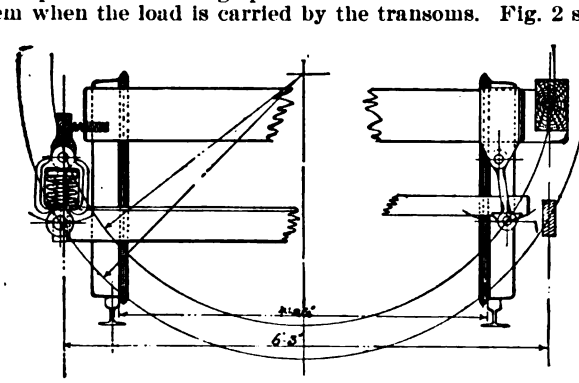


Fig. 2.—Brill Pivotal Truck.

In both cases the center plate is taken as the center of motion and supports the circles representing the lines of motion. With the old style of link the radius of motion is that of the inner circle. The radius of the outer circle is obtained by placing the hangers outside the wheels as shown. The motion, of course, will be slower in proportion to the greater radius and correspondingly easier.

One of the novel and most ingenious features of the truck is found in the equalizers. These are straight, forged bars, carried by spring links, or stirrups, upon their ends. At the centers they are solidly connected with the spring plank. The equalizer, spring plank and the swing bolster move together in the side motion. Its construction and disposition enable it to perform all that is possible for an equalizer.

The spring links are a novel feature of the truck. It consists of a steel stirrup in which there is a space for an 8-inch spiral. A follower is placed on top of the spring and an eyebolt is screwed into it. They differ from the ordinary link in position, action and in possessing elasticity. While they perform all the functions of the common swing link, they also cushion the side motion. For this reason the danger of jumping the track on curves is practically eliminated.

THE A. B. NOYES ELECTRIC CO.

The A. B. Noyes Electric Company, of St. Johnsbury, Vt., have issued a circular calling attention to the fact that they are extending their electric business and have made arrangements by which they are prepared to do first-class up-to-date engineering work, for which they shall make an especially low rate of charge.

They are manufacturing a highly efficient and well-built direct current dynamo for isolated lighting in shops, mills, etc., and have installed at the Hotel Look-Off, Sugar Hill, N. H., a complete plant consisting of 500 arc and incandescent lights and two electric motors running pumps.

Mr. Ernest Gonzenbach, the company's electrical engineer, has just completed the construction of the electric light and power plant for the town of Barton, Vt., which operates a distance of 14½ miles at 6,300 volts, and is the longest line of electrical power transmission in the Eastern States. They are consulting engineers for the St. Johnsbury Electric Company, and have recently drawn important plans for the extension of their system.

THE RUSHMORE PROJECTORS.

The high power marine projectors built by the Rushmore Dynamo Works, of Jersey City, N. J., have replaced nearly all the old reflector lights as well as many of the finest French and other projectors. The power and penetration of these lights far surpass the finest apparatus previously used in the navies. They are making these lights in large numbers, and with their improved lens-making plant have succeeded in reducing the price to less than obtained last year for the old style reflector lights.

They have sold over 100 lights this year for naval and commercial vessels, the acceptance of each light being subject to its giving entire satisfaction and so great has been their success that every light shipped has been promptly accepted. They have installed this season over fifty complete electric fountain lights, including fifteen for the Union Traction Company, for their handsome electric fountain at Willow Grove, Philadelphia, and they are now building a 100,000,000 candle-power projector for the tower of the new Siegel-Cooper building, New York City. This light will be visible fifty miles at sea.

Department News Items will be found in advertising pages.

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ELECTRIC LIGHTING.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST MILLENNIUM EXHIBITION.—I.

BY ALFRED O. DUBSKY.

ALTERNATING currents have come into general use during these ten years, not only for lighting purposes, but also, and more particularly of late, for transmission of power. It is quite natural that the history of their progressive development and their actual state should be of general interest, and the present exhibition at Budapest, the success of which surpasses all expectations, is particularly adapted for making the retrospect mentioned above. For it was on this same spot that, in the year 1885, the alternating current started on its triumphal march; it was only after this first practical experiment that it may be said to have reached the position of commercial importance. The employment of transformers with closed magnetic circuit, as well as the possibility of their parallel

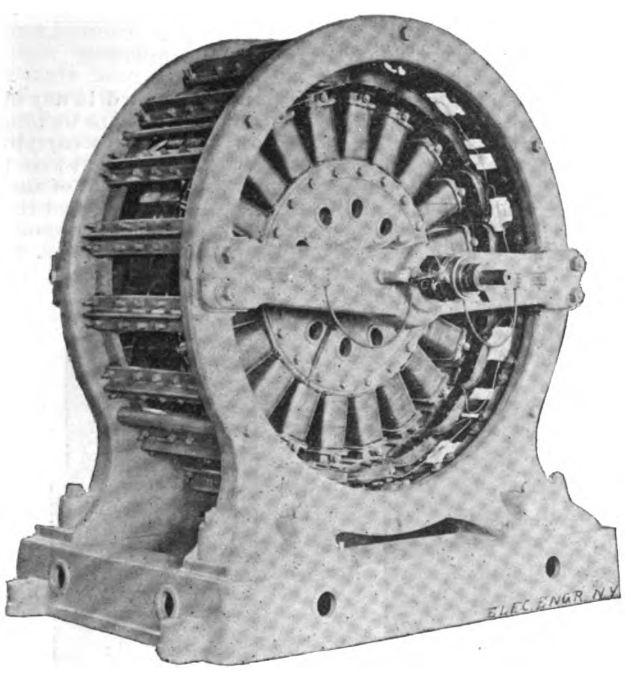


FIG. 1.—GANZ & CO. 80-KILOWATT SINGLE-PHASE ALTERNATOR.

working, are nowadays well known details. Nevertheless we should not forget that during more than thirty years we had no exact knowledge of the working of induction apparatus. Moreover, even after these first successes there were many who doubted the practical value of the above mentioned experiments.

It was at the last Budapest Exhibition, in 1885, that the possibility of the practical use of transformers was first clearly demonstrated. It was the natural continuation of the admirable work of Gaulard and Gibbs, but in a more practical direction. Almost the entire lighting of this exhibition was done according to the directions and plans of Messrs. Blathy, Zipernowsky and Déri, who created a system which during these past ten years has spread all over the world. There were then shown the first transformers with closed magnetic circuit employed for public lighting, and their parallel working never caused any serious difficulty from the first experiments.

An exhibition always demands very brilliant lighting and a comparatively large transmission of power. These are ideal conditions for showing the advantages of every system. During the evening it is the lighting which is of the greatest importance, but during the day when the different motors in the exhibition are running, the demand for power is the greatest.

Notwithstanding their real advantages, polyphase currents are not commonly employed for circuits serving only for lighting purposes or in cases when the demand for motors is a question of secondary importance. Modern polyphase dynamos with moderate armature reaction and most ingenious connection devices have diminished greatly the drawbacks of unequally loaded branches. Nevertheless, they have not wholly disappeared; but, on the other hand, it is true that these drawbacks are less noticeable, if the number of motors fed from the same circuits is large. This circumstance is due to the well-known equalizing action of working motors. Nevertheless, I dare say that for certain purposes single-phase currents have not lost anything of the importance which they had before the practical use of polyphase currents. In view of the facts mentioned above, both systems are duly represented in the present exhibition: Single-phase currents for lighting purposes and for a quite considerable number of different motors; polyphase currents for the transmission of power.

The lighting of the present exhibition is done in the same manner as the system of 1885: High-tension distribution with parallel working transformers. There is, of course, a very large difference between the transformer of 1885 and the apparatus at present employed at the exhibition. The former is of a form rather out of fashion, but is perhaps still well known from older descriptions.

I. SINGLE-PHASE CURRENT MACHINERY.—CENTRAL STATION.

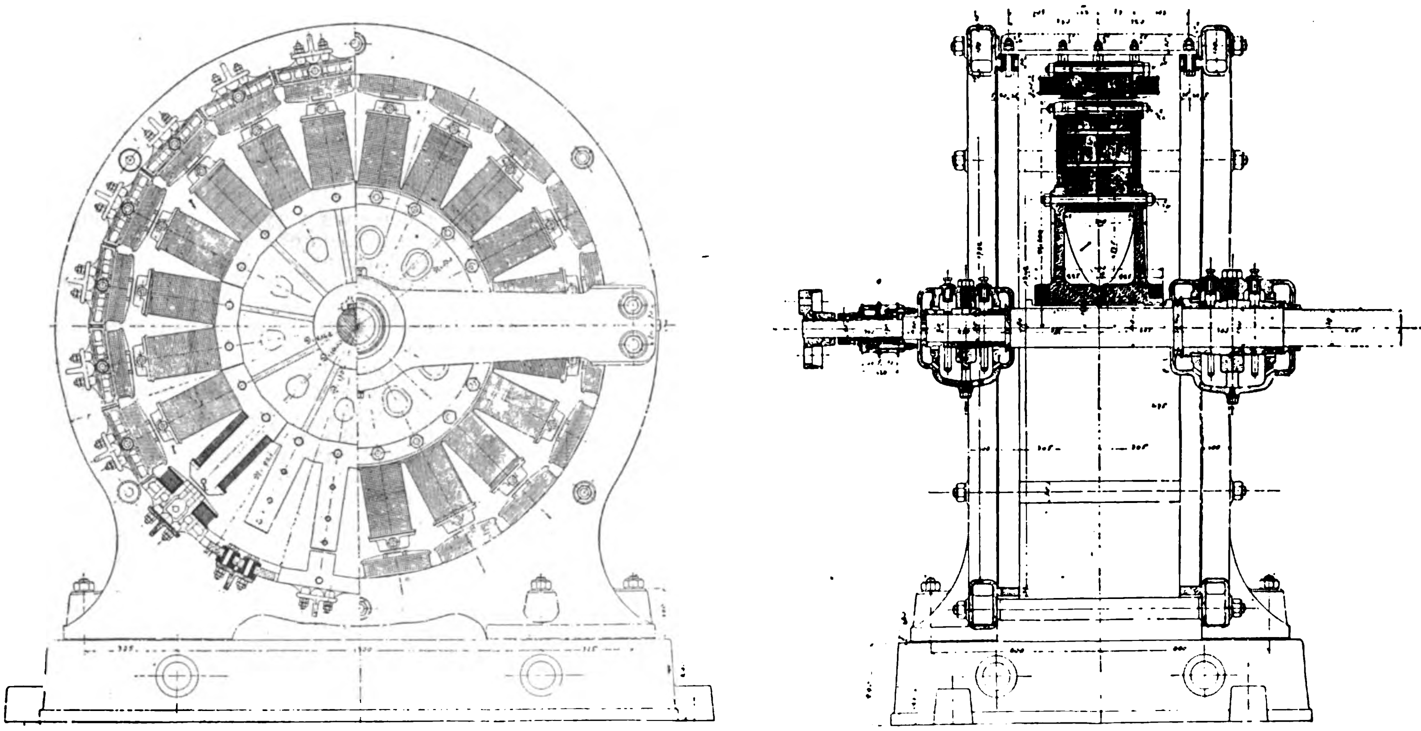
The alternating current central station for the lighting of the exhibition has two dynamos of about 160 horse-power each. They are both connected to the bus-bars and are coupled daily in parallel; moreover, two three-phase current dynamos, each of 200 horse-power, give one-half of their power on the lighting circuit in the form of a single-phase current. All these machines give light only for one-quarter of the exhibition; three-quarters of it are lighted by the two large central stations of the city of Budapest. The distribution is made at a pressure of 2,000 volts and there are different sub-stations and single transformers serving for distributing centers. I shall treat of the three-phase dynamos, which are of a very interesting construction, in a subsequent article, confining myself at present to the single-phase generators.

These generators are constructed by the well-known firm, Messrs. Ganz & Co. They are coupled directly to their steam engines and the exciting current is furnished by two continuous current dynamos, also direct connected to the generator shafts. The number of periods of the whole altenating plant is 42 per second, the lowest admissible for arc lighting. The advantages of a low frequency are too well known to require further elucidation.

The engraving, Fig. 1, shows one of the generators exhibited, which is of the same type as those employed in the exhibition lighting plant. It is of 80 kilowatt capacity; another, of 400 kilowatt, is the type employed in the large central stations of Budapest and Vienna. All these machines are of the same construction, namely, with stationary armature and revolving field magnets.

The engravings, Figs. 2 and 3, show the machine in elevation and section. The armature bobbins are placed on the outer ring of the machine, which is formed of L-shaped iron cores, consisting of insulated iron strips, which are pressed together by screws. The armature windings are put upon the several magnet limbs. The cores are fixed to cross-bars, which again are bolted on both sides of the circular-shaped frames of the machines. The advantage of this construction is, that any armature spool can be replaced by a new one at any time without disturbing the other parts of the machine.

The field magnets consist of a star-shaped core and the exciting bobbins are slid over the projecting arms. The core is built up of iron strips assembled in a manner that the joints in one layer are covered by the iron in the following layer. It is now quite easy to see how to replace the winding of any field mag-



FIGS. 2 AND 3.—GANZ & CO. 80-KILOWATT ALTERNATOR.—ELEVATION AND SECTION.

net. Dismounting the opposite armature bobbin we get an opening in a radial direction large enough to take off the field bobbin, if the screws serving to hold it are removed.

The machines of this type have all a relatively moderate armature reaction, and besides, the short circuit current through an ampere meter reaches only about two and a half times its normal load value, if the dynamo is not too much excited. Therefore, no damage to the winding can happen in regular work. I give in Fig. 4 a working characteristic at no load of the above described 80 kilowatt single-phase generator.

The machine was run at the ordinary tension of about 2,000

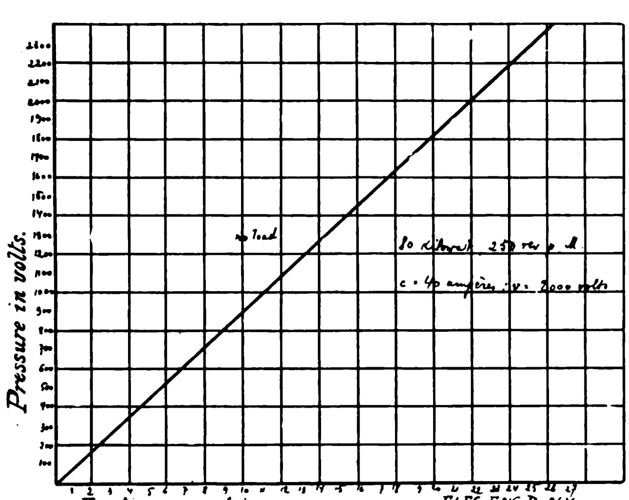


FIG. 4.—CHARACTERISTIC OF 80-KILOWATT ALTERNATOR.

volts. The pressure is drawn on the vertical line; on the horizontal line is noted the value of the existing current in amperes.

The constancy of the voltage even for widely varying loads is easily obtained by an automatic rheostat of the Blathy type. This apparatus consists of a wooden frame, Fig. 5, bearing the wire resistances. These terminate in ends which form a sloping surface and dip into a basin of mercury. The basin has an automatic vertical movement in both directions, depending on the terminal pressure at the machine. When it reaches its highest position each wire end dips into the mercury and all the resistance is short circuited; in its lowest position the bars are drawn out from the mercury, and all the resistance is inserted. In any other position there is always a different number of bars dipping in the mercury. The basin is fixed to a vertical tube carrying a piece of iron in its interior; at its bottom it is screwed to a float gauge dipping into a water tank at the bottom of the apparatus. The action of the float gauge is upward; just the inverse action is produced by a special bobbin placed around the iron core. This latter action is, of course, a magnetic one. There

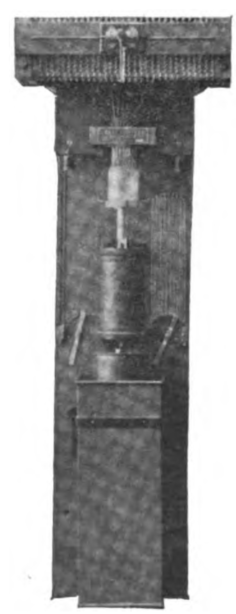


FIG. 5.

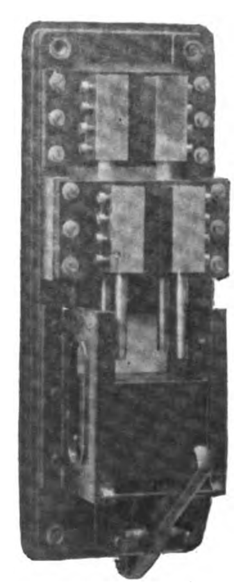


FIG. 6.

are regulating weights attached to the moving part and they are chosen in such a way that admitting a certain determined current in the bobbin the iron core should be well balanced in each position. If this current be changed the iron core will shift its position till the regular and normal conditions are reestablished.

The dynamos I have described above work very satis-

factorily with this mode of regulation. The variations of voltage produced by the sudden connecting of motors are very small, and even these are quickly balanced by the excellent equalizing action of these regulators.

The parallel working of the two lighting engines in the exhibition running nearly the whole day can be witnessed daily and is carried out without the slightest difficulty. Let us be sincere and admit that it is perhaps due more to the constructor of the steam engine than to the dynamo builder. The parallel working of the first generators made by Messrs. Ganz & Co. was a daily occurrence when it was still a much discussed question whether parallel working was practically possible. In the year of 1886 the alternators at Treviso could be coupled to the same bars; in this installation the dynamos were driven independently by belts. But in 1888 Rome had the first central station in the world where alternators driven by independent steam engines had to work in parallel upon the same network of distribution. The steam engines were fitted up with ordinary Porter governors and there were never any serious difficulties in regular working.

It is quite certain that the value of armature self-induction has a great influence upon the facility of parallel working, as it influences greatly the mutual elasticity of the alternators. But between certain limits, which should be carefully observed, it is chiefly upon the steam engine that the satisfactory parallel running of the generators depends. The other alternators of the exhibition specially built for power distribution, and having therefore a smaller armature self-induction and a comparatively high magnetization, have been connected as easily in parallel as the special lighting machines, which latter have a relatively smaller magnetization.

Parallel working at the exhibition is done by first loading the machine to be coupled in parallel by a variable resistance to the same degree as the other which is already working. A voltmeter indicates the moment when the two generators are in phase, at which time the coupling switch is thrown. Afterward the loading resistance is withdrawn by degrees from the main circuits.

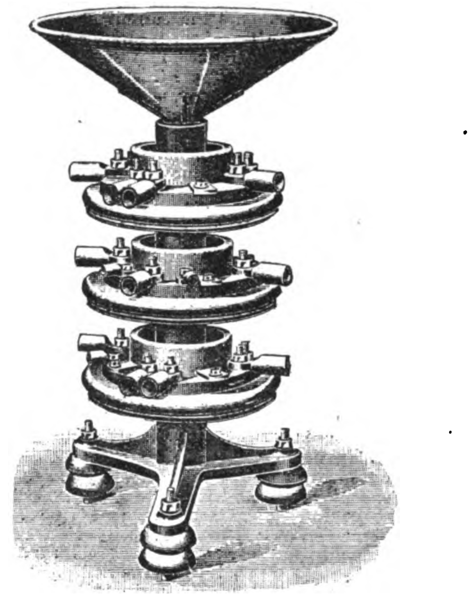
The switches used on the switchboard for high tension work are all mercury apparatus. They have very great advantages, as their manipulation is very easy and without any danger; they have been constructed for current intensities of 100 amperes and more. It is true that for strong currents these switches are heavy, but it is just this weight which assures the rapid break of the circuit. The apparatus shown in Fig. 6 is designed to carry 50 amperes. There are four contact pieces provided with long bars. The lower basin is made of ebonite and contains two mercury cups thoroughly insulated. The whole basin can slide in the vertical direction; raising it by lever shown causes the bars to dip into the mercury. By this means the bars enter into electrical connection.

THE WORDINGHAM PILLAR DISTRIBUTOR.

To secure equality of pressure it is desirable to inter-connect a distributing network at as many points as possible. The great drawback to such inter-connection is, however, the difficulty of localizing a fault should one occur, and with a view to providing for this it is essential that all linking points should be capable of rapid disconnection. This is by no means easy to provide for in a neat and convenient manner when there are many cables meeting in one point, and the difficulty is very largely increased when the distribution is effected on the five-wire system, since the number of cables is largely augmented. The necessity for some convenient apparatus for this purpose has led Mr. C. H. Wordingham (Municipal Electrical Engineer at Manchester, Eng.) to devise the apparatus illustrated on this page.

A central hollow cast-iron column standing on three oil insulators is fixed in the junction box. From this column project at five different levels three cast-iron lugs 120 deg. apart, cast in one with the column. Five cast-iron plates, each having three slots separated from one another by 120 deg., and three recesses on the under side placed between the slots, are provided. One of these plates is slipped over the pillar, the slots allowing it to pass the lugs until the bottom three lugs are reached. The plate is then turned through an angle till the recesses are opposite the lugs. The plate is then dropped down, and takes a firm seat. On the plate are placed two flat rubber rings which serve as a bed for a porcelain insulator of the form shown. This insulator is large enough to slip past the cast-iron lugs. Three slate wedges covered with india-rubber strip are placed between the insulator and the pillar, so that the insulator is firmly fixed. A substantial ring of gunmetal is now placed on the insulator; this ring is prevented from slipping about by means of four small brass pieces secured by bolts and rendered adjustable by means of slots. This ring has studs and tapped holes which admit of a large number of lugs into which cables are sweated, being affixed to it by means of nuts and bolts. A second cast-iron plate is now slid down the pillar and fixed on the next three lugs from the bottom, and an insulator and ring placed on it as before described. Three more cast-iron plates, each with its insulator and ring, are then fixed on the remaining lugs. A large funnel is slipped on to the top of the pillar. This serves to collect any water that may drip into the junction box, and so prevents it from falling on the apparatus; the water runs down the funnel through the interior of the column.

The illustration shows a three-ring distributor complete



WORDINGHAM PILLAR DISTRIBUTOR.

without any cables attached. Such a pillar distributor is capable of dealing with a very large number of cables. Each ring can readily have six ½ square inch cables and six smaller ones attached to it, that is to say, the pillar as a whole will deal with 70 cables. A considerable number of these distributors have been introduced into the Manchester network. It is quite easy to disconnect the five cables which pass down a street in as many minutes, and, in case of a fault, portions of the network from which a large supply is being taken can be broken with perfect safety. On one occasion as much as 1,700 amperes at 200 volts was successfully disconnected on one of these pillars.

PROPOSED CITY PLANT FOR PAWTUCKET, R. I.

Both branches of the City Council met June 27 for the purpose of listening to the report of Mr. C. O. Mailloux, electrical engineer, upon the feasibility of the city establishing a municipal electric lighting plant. The report was presented, and was long, exhaustive and yet unfinished. But the following summing up contains the gist of the whole: First, the use of arc lights is recommended for the street lighting. The candle-power should be limited to 1,200. The lighting of the outlying portions might remain as it is for the present. Second, the city could afford to install at least 350 arc lights to begin with. The present distribution of lamps is very faulty and should be thoroughly revised. Third, the city has sufficient use for indoor lights, and can operate these lights from its own plant at sufficiently low cost to justify it in providing the necessary facilities for the purpose. Fourth, the plant can be located near pumping station No. 1. Fifth, the cost of equipment will vary with the kind and character of equipment adopted and the number of lights operated, from $68,000 to $86,000 for the arc street lighting equipment alone. The incandescent lighting equipment will add from $5,600 to $6,300. Total cost of both equipments will range from $73,000 to about $92,000. Sixth, the cost of operating will range from a yearly total of $16,700 to $20,200 (in round numbers), according to the kind of equipment adopted, and the total number of lamps operated. The cost per lamp per year will likewise vary from $49.79 to $56.91. The total cost of alternating current production for the municipal indoor lighting will range from $1,000 to $1,500 per year.

The matter will soon come up for vote.

MUNICIPAL ADVANTAGES.—HOW TO OBTAIN THEM.—II.

BY ALLEN R. FOOTE.

WANT OF APPRECIATION.

The most serious aspect of the question is the spirit of antagonism against corporations that is being engendered in public opinion by persistent, well-meaning, but misinformed persons. In the volume referred to, published by the National Municipal League for Good City Government, there are some forty references to the franchise question by speakers from different cities, every one of whom speaks about the giving away of franchises, as though that had ever been done. A franchise is given away only when the municipality receives no consideration. The consideration of highest value is the benefit of the public advantage. This advantage is effective in the direct proportion of service rendered to necessary capitalization. It is not unusual to find the announcement that, to illustrate, a street railroad company has obtained a franchise by "paying a handsome figure. Gives a bonus of $250,000 and 38½ per cent. of gross receipts." A little later comes the announcement that the "bill is popular." "Belief that 3-cent fares will compel street railway companies to reform."

Again, these friends of the people advise "managers of steam and surface roads that they will add to their popularity and increase their revenues by making a 5-cent fare to all points within specified limits. If the railroads would cut down their fares to 5 cents, this territory would be speedily built up. The taxable property of the city would thus be added to, and the roads would find their profit in a steady increase of trade." These three phases of the question are all presented in one of the leading newspapers of the country within six months. Is it a wonder that there should be a spirit of antagonism to corporations when the public mind is dependent for instruction upon this kind of written-to-make-the-paper-sell information? In another city, an effort is being made to get a street car line constructed to a suburban park. In this instance the headlines read, "Valuation of property in the vicinity likely to be increased fifty times if the plans suggested are to be carried into effect." This is the talk now. When the road is in operation and the real estate owners have secured the advance of "fifty times" on the value of their property and the municipality has been benefited by a large increase in the valuation of taxable property, and the railroad is paying, say, 10 per cent. dividends, there will come the demand to "down this monopoly" by increasing its rate of taxation, adding to its burdens by compelling it to repave, repair, and clean the streets through which it passes, and to reduce its fares. The worst of it all is, because not properly taught, the honest-minded, but misinformed masses will support these demands.

Going to the other extreme, there are those whose appreciation of the advantages of the public services rendered by corporations is so great they advocate the policy of having the municipality take possession of all the street railroads, carrying passengers without charge, and provide for the cost of operation by general taxation.

JUST CAUSE FOR APPRECIATION.

All that is required to generate a true appreciation of the economic advantages derived from the services rendered by public service corporations is to have the exact truth told regarding them.

In New Haven, 1885, the electric light company furnished 31 arc lamps on a one-year contract at $237.25 per lamp per year. This company is now under a three years' contract to supply 400 lamps at $98.55 per lamp per year.

400 lamps at $237.25, price of 1885..	$94,900.00
400 lamps at 98.55, price of 1896..	39,420.00
Saving for pockets of taxpayers, per year	$55,480.00

The facts in relation to the New Haven Gas Company are as follows: The price of gas in 1873 was $3 per 1,000 cubic feet. Since March 5, 1895, it has been $1.25. The sale of gas for the year ending December, 1895, was 246,217,000 feet.

246,217,000 feet at $3.00, price of 1873..	$738,651.00
246,217,000 feet at 1.25, price of 1895..	307,771.25
Saving for pockets of taxpayers and consumers, per year	$430,879.75

We are justified in taking a broader view. Mr. Mulhall, the leading statistician of the world, states: "A saving of 3.56 a ton on freights which has been effected by means of railways, means a fall of 12 per cent. in the price of all commodities, without loss to any one."

The "Journal des Economistes," France, states the ordinary freight charges per ton on railways as follows:

	Price per 100 miles.
United States	$ .40
Holland	.78
Belgium	.80
Germany	.82
France	1.10
Russia	1.20
Italy	1.25
Great Britain	1.40
Average	.97.

This shows an average of a penny a mile, as compared with 8 cts. in 1850. But while, in every country the benefits resulting to the community from the construction of railways have been equivalent to an annual dividend of 40 or 50 per cent. on their cost, the results to the capitalists and shareholders who provided the necessary money have been by no means encouraging. If we take the average returns of net receipts for the years 1887-88, we find that only in two countries did they reach 5 per cent., the average for Europe being less than 4 per cent. (3.7), and for the world only a fraction over 3 per cent., as shown in the following table:

United Kingdom	4.1
France	3.8
Germany	5.1
Russia	3.3
Austria	3.1
Italy	2.5
Sweden	2.9
Belgium	4.6
United States	3.1
Canada	1.7
Spanish America	1.6
India	5.2
Australia	3.3
Egypt	4.1
The world	3.2.

This evidence, showing that public service corporations are entitled to high appreciation and would receive it, if the truth regarding them were fully impressed upon public attention by the friends of the people, may be closed by a reference to that shining mark of the advocates of government ownership of industrial monopolies, the Western Union Telegraph Company. Its average toll per message in 1868 was $1.047. In 1895 it was $0.307. The number of messages handled in 1895 was 58,307,317.

58,307,317 messages at $1.047, price of 1868.	$61,047,758.80
58,307,315 messages at .307, price of 1895.	17,900,345.70
Saving in the pockets of users, per year,	$43,147,413.10

This saving represents a dividend to the public of nearly 50 per cent. on the capitalization of the company, while the dividend paid to shareholders is only 6 per cent.

Facts such as these, and a correct understanding of the economic principles involved in the question of governmental vs. the private ownership and operation of industrial monopolies, will cause the demand for the municipal ownership of gas and electric lighting plants to disappear, and will counteract the unjust antagonism that has been and is still being engendered in the public mind by those who do not think accurately.

Here are indisputable instances of substantial dividends left in the pockets of the users of services supplied by public service corporations and of taxpayers. In the light of facts such as these, and the cold, stern records of experience that will certainly be made in the future, the "substantially true" saving promised by Mr. Dow to Detroit taxpayers, will be found, the longer and the more critically it is examined, to be of diminishing largeness.

I now reassert an affirmation made in 1890:

There is not a municipal-owned gas or electric light plant in the United States which private capital will not take over and operate under contract, at the same price the service is now costing the municipality, all factors of cost being correctly and fully considered, and all franchise rights enjoyed by the municipality being assigned to the purchasing private corporation.

One of my critics has said that I am right in the position I have taken on this subject, but that I am in advance of the times. In his opinion, after fifty years of discussion and many costly experiments, the question will be settled about on the lines I have indicated. If the public requires fifty years in which to educate itself to my position, I certainly cannot be held responsible for that. If I am right now, I shall be right then, and shall be glad to see you.

It is a difficult thing to cause a people to think rightly.

Electric Transportation.

THE SCOTT & JANNEY SINGLE-PHASE ALTERNATING RAILWAY MOTOR.

BY GORDON J. SCOTT.

KNOWING that it has been the endeavor of electrical engineers and inventors for some years to discover some means by which it would be possible to operate electric railway cars with single-phase systems, the following description of the Scott & Janney system will no doubt interest many who have been engaged upon similar work.

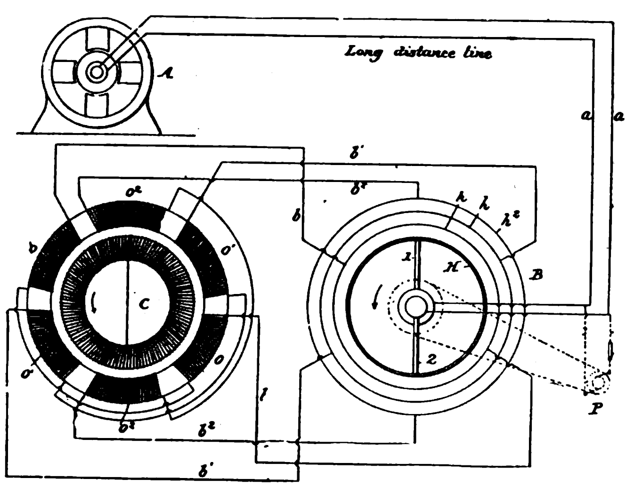


FIG. 1.

First, it may be advisable to tell in a few words why single-phase alternating current motors have not been employed upon railway cars.

There have been no single-phase motors built up to the present time which were load-starting in the full sense of the word, which were designed to run on a two-wire circuit without commutators and be economical. Even giving the self-starting (as distinguished from load-starting) motor its due, allowing it to self-start and run at synchronous speed, operating a direct-current dynamo and direct-current motors, the economy and regulation factors go side by side with each other, and go far toward making up the inefficiency of such portable central stations.

Alternating currents have little or no respect for commutators and brushes, and while it is possible to make single-phase motors with commutators it is a source of constant expense and annoyance to keep them going, and as railway motors they would rival some of the early types of street car motors in chewing up brushes and commutators.

The two-phase and polyphase systems of course can be employed, but the use of two trolleys is not to the liking of railway people in general, as one ordinarily satisfies the needs of all concerned. In addition to this the best polyphase motors hesitate when it comes to starting a loaded street car or stripping the teeth off a gear or pinion, and object to being forced. They are also very inefficient, except when running in synchronism, which they cannot always do.

In the course of our experiments we found that a two-wire system could be employed to do the work to the satisfaction of every demand made upon a railway motor. The motor which will be employed is a rotary field motor, single phase. We mention this now in order that there will be no misunderstanding, the difference between a rotary field and a polyphase motor being very decided, although it will be difficult for some to see it at a glance.

We have first, B, Fig. 1, what we have termed an "induction director," as upon this piece of apparatus the effectiveness of the system and of the motor in particular depends. The induction director takes the current from the line and acts, as its name implies, as the director over the motors connected with it. It may be connected in a great many different ways for different cases and results. Its chief duty is to create a rotating field in the motor or motors which are connected to it, which rotary field may have two, or one hundred, poles about a given armature, and which poles moreover rotate at any speed that the director may elect at the will of the motorman.

The velocity of the rotating field being a variable and being under absolute control, it is readily understood why a very great starting effort can be obtained. It is practically the same as if the frequency on any alternating polyphase system was variable, and the dynamo and motor brought up to speed at the same time. This, every one knows, would only do and is only done where all the power of a dynamo is absorbed by one motor or where all the motors on any circuit are shut down or all running at once, or, in other words, are not independent.

The theoretically perfect system of motor control is that in which the e. m. f. and current are both variable at will on any given motor without employing a resistance in the circuits to obtain such variation. This we are enabled to do with alternating apparatus as the C^2R loss on a street car equipment, even at the slowest possible speeds, is very small. The question of distance does not cut any figure for ordinary railways. A 100-mile railroad operated from one station can be as easily operated and more economically than the best direct-current railway of to-day; the enormous copper investment would be done away with. Alternating machinery of every kind is more durable than direct-current apparatus, on account of the ease with which the insulation may be placed.

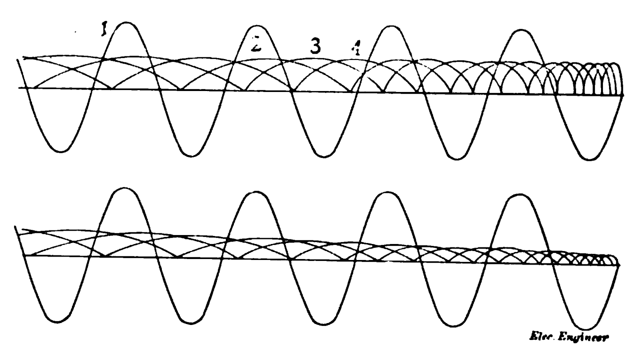
We will take for our present needs Fig. 1, which shows one of the ways in which our system can be operated. A shows the alternate current dynamo; a, a, are the two wires for long-distance transmission; P is a small variable speed alternate current motor which is employed to drive the primary circuit or the sliding contacts upon either of the circuits. The induction director, B, is an extremely useful piece of apparatus with which to deal with alternating currents. It is used to create a difference of potential electrically upon circular rings, H, and then by the proper connection of the circuits with windings upon a field arranged about a motor armature, to create differences of magnetic potential. This establishes poles in the field magnets which can be rotated at will about the armature, either fast or slow, and in either direction, and these poles can be made strong or weak, according to the demand upon the motor.

Another very important feature is the fact that the coils upon field and armature may be connected in series or in parallel, as desired, in order that a very great starting torque may be obtained with a small amount of energy, or that a very great speed may be obtained with a larger amount of energy.

Due to the fact that the points of greatest difference of electrical potential cut or pass through every point of circumference of 360 degrees at a constant average pressure, it follows that the magnetic potential will be of necessity as constant as the cause producing it, and the poles will pass through every point upon the circumference. There will be no position of the armature where it will not be acted upon by the field. There will not be the tendency in these motors to blow out the lines of force in the gap space as do all two-phase, three-phase, and, in fact, all motors of the induction type, in which the slip at starting is determined by the frequency and number of poles about the armature.

With our system the frequency has no relation to this slip, neither has the number of poles; the speed of the induction director controls this slip and allows the reaction between armature and field to be a maximum at all times for a given amount of energy applied.

It will be seen that in any piece of apparatus so designed that the points of greatest potential can be shifted along the length of the electrical circuit or circuits, without cutting the magnetic



FIGS. 2 AND 3.

lines, the frequency will not be changed. In the motors the curve of energy in each circuit will be positive, as it is not reversed, and as many different circuits may be run as are necessary to get the greatest average height. These curves are independent of the frequency which may vary through many cycles, while the energy curves are rising and falling once.

Fig. 2 is a diagram showing the frequency constant and the

energy curves (in this case we have three, indicated at 2, 3 and 4), variable with the speed, the areas showing the way in which the energy varies with the speed with constant e. m. f. (curve 1). With a variable e. m. f. the average height of the power line would describe a curve gradually approaching the zero line as the power required for an increasing speed decreases, Fig. 3, and then when limit of decrease is reached, the power required for a further increase of speed will increase and the power line will be a curve gradually reaching away from the zero line, which is also the base line of the power curve.

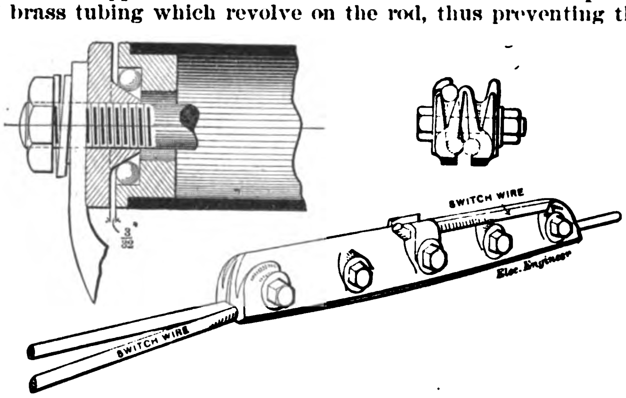
It is to be understood that Fig. 2 is a simple diagram intended to show the principle, not the actual performance, as it would require too much time at present writing to go into details.

THE NEW WALKER TROLLEY WHEEL AND TROLLEY LINE CLAMP.

The new trolley which the Walker Company has recently placed upon the market, a brief description of which was given in our columns last week, promises to be a great improvement over the old grooved wheel trolley. We give below a detail description of the trolley.

Instead of a wheel, this device has a roller 3⅝¼ inches long and 1¾ inches in diameter. This roller is made of seamless drawn steel tubing and is case-hardened. In each end of this tube is a cone made of case hardened steel, opposite which is an adjusting cone also of case-hardened steel. The bearings consist of twelve ¼-inch steel balls at each end of the roller, bearing between the two cones, as shown in Fig. 1. At a speed of five thousand revolutions per minute and a pressure of thirty pounds on the trolley wire, these bearings require no lubrication whatever, thus entirely avoiding the use of oil in the trolley bearings.

Through the roller passes a cold rolled rod which retains the cones in position and supports the roller by means of the ball bearings. The current is taken from the rod by means of small copper brushes which are secured to short pieces of brass tubing which revolve on the rod, thus preventing the



FIGS. 1, 2 AND 3.—THE NEW WALKER TROLLEY WHEEL AND CLAMP.

current passing through the ball bearings, thereby avoiding pitting of the latter due to the small contact surface.

The fork is made of malleable iron into which is fitted two pieces of 1-inch diameter seamless steel tubing which form the support for the rod passing through the roller. The ordinary trolley pole is used. The trolley has no lateral motion whatever, therefore is always parallel with the track, making it impossible for the roller to leave the wire. With this tolley switch plates on the wire are unnecessary.

Fig. 2 illustrates a trolley line clamp which is designed to attach the switch to the main trolley line, making a very substantial and inexpensive junction of the wires. The clamp is made of one piece of cast brass having two grooves running the full length of the clamp to receive the wires, as shown in the end elevation, Fig. 3, the wire slot being wide enough to admit of placing one wire in position and leaving room enough to place the other wire in position without disturbing the wire first placed. Then the clamp is closed up by means of four ⅝-inch bolts as shown in Fig. 2, which brings the two wires in close contact throughout the entire length, the switch wire being turned up over the end of the casting, lying in either groove as shown in Fig. 3; the wire continues to the center, where it passes behind the lug, which is turned down over the wire, thus preventing the possibility of pulling out the switch wire.

The bottom edges of the clamps near the end are rounded off to bring an easy rise from the bottom of the wire to the bottom of the clamp to allow the roller to have free passage under the clamp. This casting has two grooves at either end and two lugs in the center which make it unnecessary to have "rights" or "lefts," and the switch wire may be turned up from either side on either end and held in position as shown. The total weight of this clamp, including bolts, is 8½ lbs.

PROPOSED ELECTRIC TRACTION FOR BERLIN.

A paper was recently read by Dr. M. Kallmann before the Elektrotechnischer Verein, of Berlin, on "The Organization of Street Traffic." The author first drew up a picture of the rapid development of the street traffic of Berlin in the last twenty years, and stated that in the relatively small area of about twenty-three square miles, or about five times smaller than that of London, Berlin with about 1,750,000 inhabitants, has at present over 310 miles of horse and steam tramlines. These are worked by ten different companies. The concession of the largest expires in 1911. All the undertakings are considering at present the adoption of electric traction, and as there are about 33,000,000 car kilometres (20,460,000 car miles) run annually on the existing horse lines, it would take 17,000,000 kilowatt hours to operate the same electrically. The number of persons carried per car kilometre is five. Dr. Kallmann then dealt with the different systems of electric traction, and he comes to the conclusion that practically 90 per cent. of the lines can be arranged on the overhead system, leaving the remainder to be tackled by some other method. On the latter lines there could be employed either a conduit system or locomotives working with accumulators, or a mixed system as used in Hanover. As regards costs, Dr. Kallmann thinks electric traction would reduce the working expenses from 4.4 cts. to 2.8 cts. per kilometre. The cost of converting the lines would be about $5,875,000. If the supply of the current were carried out from one large generating station under the control of the municipality, the cost of energy would not exceed 2.4 cts. per kilowatt hour. As explained in a former necessary mains and feeders. The installers, being thus relieved of the erection of generating stations and cable networks, would be able to quicken the conversion of their lines. The cost of the power stations of a total capacity of 10,000 horse-power, which would be required for the working of all the existing horse lines, is estimated by Dr. Kallman at $1,500,000, and the cost of the necessary cables at $875,000. With a consumption of about 500 watt hours per car kilometre, and a tariff of 2.2 cts. per kilowatt hour, the cost of energy per car kilometre would be 1 cent.

A good idea of the working of a central station for light and power is given by the Hamburg station. According to the returns for 1895 the total number of units generated amounted to 5,500,000, of which about 4,000,000, or about 75 per cent., were used for traction. The total cost per unit generated was 1.58 cts., but it is expected that with the erection of 1,000 horse-power engines this figure will be reduced to 1.4 cts. or 1.3 cts. With a consumption of over 20,000,000 kilowatt hours for all the Berlin tramways the total annual expenses would be from $450,000 to $500,000, which the tramway companies would have to pay to the electricity works.

Dr. Kallmann all through his paper advocates the centralization of electric supply stations and their municipal ownership, and believes this to be a great advantage to electric tramway companies.

ELECTRIC TRACTION IN ROME.

The municipality of Rome has approved a measure compelling the Roman Tramways Company to entirely abolish horse traction and to substitute electric traction on its entire network, urban and suburban; the transformation to be completed within four years. The overhead trolley system will be adopted on most lines, with the Siemens underground conduit in the principal thoroughfares. The work will be entrusted partly to the General Electric Company of America and partly to Messrs. Siemens & Halske, of Berlin. The work is in active progress. The motive power will, it is expected, be derived from the Tivoli-Rome transmission, additional power being transmitted by polyphase currents. We learn in this connection that Messrs. Siemens & Halske have for some time past been making, and successfully using, shunt-wound motors for electric traction purposes at Halle, and these will probably be used in Rome. In the new motors the field is so

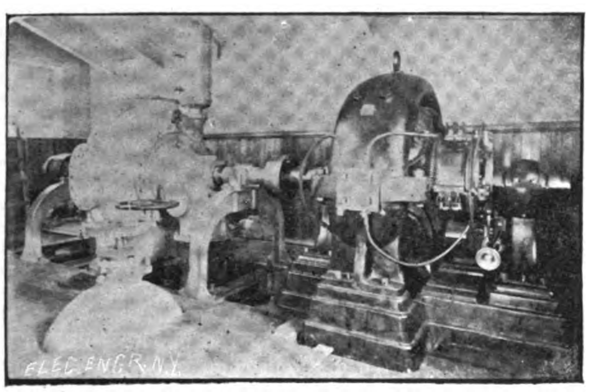
massive and the magnetism is so strongly retained after interruption of the exciting circuit, as to entirely do away with any evil consequences resulting from momentary interruption of the current. The cost of the shunt-wound motors is, however, some 15 or 20 per cent. greater than that of the usual series-wound ones.

POWER TRANSMISSION.

ELECTRIC POWER IN THE CLIFF PAPER MILLS, NIAGARA FALLS.

Several months ago we described the double use of the waterfall at Niagara in the mills of the Cliff Paper Co., first at the top of the cliff and again at the bottom near the lower level of the Falls, 250 feet below.

Greatly encouraged by the results obtained, the company recognized the fact that they could generate electric power very cheaply, and so, at the rear of the pulp mill they excavated back into the slope of the bank a sufficient distance to allow of the erection of a building 25 feet wide and 30 feet long for a generating room, and it is there that the new electrical plant has been installed. This plant, which went into operation on July 10, consists of two 150 horse-power generators made by the Card Electric Company, of Mansfield, O., and installed by F. W. Oliver Company, of Niagara Falls; they are attached direct to a 300 horse-power horizontal turbine made by James Leffel & Co., of Springfield, O., the



GENERATING UNIT, CLIFF PAPER CO., NIAGARA FALLS.

combination being illustrated in the accompanying engraving. The ordinary speed of the generators is 650 r. p. m., but they are so designed that they can be run at 800 r. p. m., if desired. The generators can be run single or in multiple, or either or both machines can be disconnected from the water wheel. The switchboard used in connection with them was designed and built by the Oliver Company.

The current is carried from the generators on 300,000 c. m. rubber covered cables up through the elevator shaft to the motor room situated on one of the lower floors of the paper mill. These motors will be three in number, two being of 100 horse-power each and one of 12 horse-power. The motors were made by the American Engine Company, of Bound Brook, N. J. Only one of the 100 h. p. motors has been installed so far, but the other is expected daily. These large motors will be used in operating the two Foudrinier paper machines while the small motor will run the machine shop connected with the mill. The water supply for the turbine which operates the generators is taken from the eight-foot penstock of the pulp mill through a 36-inch connection running under the floor of the new generator room and connecting with the Leffel turbine. This supply for the wheel can be shut off by means of a valve so as not to disturb the pulp mill supply. The two draft tubes from the turbine meet and extend as one through the wall of the pulp mill into the tailrace. Steadiness of motion is obtained by a Replogle governor..

In the matter of power the Cliff Paper Company's plant is thoroughly well equipped, for it has water, steam and electric power. The new electric plant will do away with the use of steam to the extent of 250 horse-power, and they anticipate a saving both in the matter of repairs and in their coal bill. For the time being they will continue to use steam in their drying machines, but it is probable that the future will see electricity occupying this field also. The present output of the Cliff mills is 25 tons of paper and 30 tons of pulp a day.

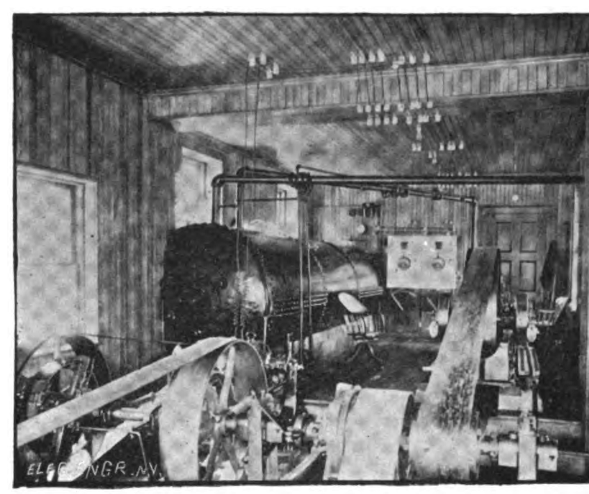
The power for running the mill plant is obtained from the Niagara Falls Hydraulic Power & Mfg. Co.

A DRAWBRIDGE OPERATED ELECTRICALLY AT UTICA, N. Y.

The bridge over the Erie Canal on Genesee street in Utica, N. Y., had for some time been the cause of much inconvenience to residents of that city and the canal officials, by reason of its irregularity of operation, until the method now in use was resorted to.

As originally planned, the bridge had one stationary center span and two lifts, one on each side. Each lift was to be raised by a 15 horse-power electric motor, carried on the lift and operating a vertical screw on the principle of the common screw jack, but this plan was abandoned when it was found to require about 75 horse-power on each lift to raise it. Compressed air was substituted by placing two cylinders under each lift and attaching their pistons thereto. An air compressor was located in the old weigh-lock building about a block distant and was operated by a turbine wheel taking water from the canal. This plan was only a partial remedy and during the periods of low water in the canal the bridge had to be "hung up," as the air compressor could not run.

To overcome these obstacles one of the 15 horse-power mo-



BRIDGE-LIFTING PLANT AT UTICA, N. Y.

tors which had been on the bridge was temporarily belted to the compressor late last season. This was found to work very satisfactorily, and in the spring an addition was made to the weigh-lock building and a permanent installation of the two motors was made by Messrs. Nightingale, Johnson & Co., of Utica, under the direction of M. H. Johnson, as shown in the accompanying engraving.

The installation consists of two 15 horse-power, 500-volt Thomson-Houston series motors and a 20-inch turbine water-wheel belted to friction clutch pulleys on a shaft which is also belted to a compound Norwalk air compressor. A white marble switchboard stands at one end of the room with the instruments, switches and regulating rheostats on it, and this, with a small circular pump and 72-inch by 18-foot air receiver, completes the equipment.

The bridge is normally operated by air at 260 lbs. pressure and no difficulty or hitch has been experienced in its operation since the installation was completed. This is quite a model plant in all details and is an instance of the great flexibility of electricity, as, after being abandoned in the first instance, it was again resorted to as the only means of procuring reliable and economical operation.

MR. J. W. BRAID has been appointed chief of the Electricity Department of the Tennessee Centennial Exposition. He has had a room fixed up in one corner of the Minerals and Forestry Building, and there he has a force of men preparing electrical fixtures for use hereafter. Particular stress is being laid on this department by the management of the exposition.

TELEPHONY AND TELEGRAPHY.

MR. DELANY ON GOVERNMENT TELEGRAPHY.[1]

IT is a curious fact that while great improvements have been made in telegraphy, and notwithstanding that telephony has come and covered the earth with its wires within the past twenty years, the arguments put forward against postal telegraphy have not changed in the slightest degree.

It is significant that none of the improved methods of telegraphy now in use originated within the controlling telegraph organization, all having come to it by purchase of competing lines, or from individuals outside. I refer to these matters because the opponents of government telegraphy have invariably advanced the argument that government control would discourage invention and improvement in systems. With the exception of its own Wheatstone system, all the great improvements used by the British post office are importations.

According to the report of the British Postmaster General for the year ending March, 1895, 66,189,000 messages, averaging 15 words each, were transmitted at an average cost of 15 cents, and, in addition, there were transmitted 5,400,000 press dispatches, averaging 120 words each, at a cost of 9 cents, or nearly 14 words for a cent. Nor is this all. There were 1,600,000 railway messages, averaging 25 words in length and representing 25 cents in value, transmitted free.

The press rate in this country averages about one-half a cent a word.

Now, as the deficit for 1895, in England, including interest account, amounted to a little over $2,500,000, it will be evident that had the free messages been paid for at regular rates and press dispatches paid for at a rate bearing the same proportion to the regular rate that such dispatches are charged for in this country, the British telegraphs would show a good balance of profit. In 1870, when the government took control, the business amounted to but 7,000,000 messages, an increase of more than tenfold in twenty-seven years, while the rates have been reduced from a maximum of about 4 shillings to a uniform rate of 6 pence.

The British operator has had two increases of pay since 1881, while his American brother has had four reductions, and to-day the British operator is better paid for the same amount of work, and by his environment occupies a higher plane of comfort and contentment, than the American operator. Good behavior and diligence in his duties warrant him a life position, from which the whim or caprice of none can drive him. His increasing years of service are taken into account in various beneficial ways. He has his yearly vacation. He is not cut off in sickness, and, most important of all, he is not "turned down" in old age, but is retired on a pension, proportioned to his years of service. I can not conceive of a stronger incentive to a government system of telegraphy in this country than the example of thorough efficiency and success presented by the British post office.

No telegraph operated by the government in any country is conducted with a view to pecuniary profit. The aim is to spend all surplus earnings in improvements and extensions, and if none are necessary, then a surplus is prevented by a reduction of charges.

No one acquainted with the executive officers and heads of departments of telegraphs in this country can charge them with incompetency or lack of clear vision. They are experienced and able officials, familiar with all the details of their business. It is, therefore, strange that the wealthy few who control and dictate the policy to be pursued have not deferred more to the opinions of these managers, and been satisfied with a slower inflation of their shareholdings. The ability to so manage a vast concern as to earn dividends on a capitalization at least double what it should be, and this in times of great depression in business, commands admiration, but surely the wealthy owners have cut out a hard task for these men. They have been so hampered as to warrant the conclusion that the most primitive methods were the conditions most desired, and that difficulties in the way of cheap telegraphy should always be encouraged in order to maintain a great discrepancy between the cost of sending a message by wire and one by train. It has always seemed to me that the natural desire for great profits could have been met much better by a policy of encouragement of improvements, warranting cheaper rates and insuring an increase in business which would more than compensate for the reduction in charges. I doubt very much whether telegraphy could be carried on any cheaper by the government than it is now conducted by the companies if the same methods of operation are to be retained. Expertness of the operator has reached its highest development. Machine methods are as old as hand manipulation, but in this country they have not been used to any considerable extent and their development taken advantage of. A wrong start has been adhered to persistently, owing in a great measure to overconstruction of competing lines and multiplication of wires; and so long as one company gathered all the others in as fast as they came along, there were wires to spare, and therefore, as those in control argued, there was no use for increasing speed. Besides, wires afforded a basis for stock issuing. If this convenient mine could have been ignored, it would have paid the companies much better to have abandoned the poorly constructed lines and concentrated traffic on a comparatively small number of well-constructed lines of high conductivity operated by machinery. The companies can hardly be blamed now for not taking down thirty poor iron wires and putting up one good copper conductor in their stead, even though it is now entirely practicable by machine working to make the single wire carry more messages for average distances than the thirty hand-worked wires, even when quadruplexed, so that four messages may go simultaneously.

The argument of those whose interests compel them to defend them by disparagement of improvements, which must surely render their great network of wires unnecessary and useless, is that machine working would be slower than hand working. With plenty of wires, no practical telegrapher will deny that a single short message can be sent by hand in the same time that it takes to perforate or prepare it for transmission by the machine system. The average layman is by this fact frequently deceived into grave error and by not pushing the comparison further. If the message be a long one, or if there are a thousand messages to transmit, it might take two days to get them off by hand, whereas, if there are a sufficient number of perforators, the whole lot could be transmitted in a few minutes. A perforating operator will prepare messages at the same rate of speed that a Morse operator can transmit them by hand, and a transcribing operator will typewrite them as rapidly as a sound-reading operator can receive, while the machine transmitter will send the dispatches as fast as 70 to 170 perforators can prepare them, or afford on an average, according to length of circuit, the same carrying capacity as 70 to 170 circuits worked by the present Morse system. One man could send them as fast as seventy men could prepare them.

Mr. Chairman, without machine transmission, government telegraphy, under the provisions of this or any other bill would not be practicable, and the rates stipulated may be seriously questioned on the basis of present hand methods of operation. In expressing this opinion I have no fear of contradiction from any disinterested telegrapher. I do not think that any government management could possible conduct a telegraph service on a cheaper basis at the present capitalization and by the present methods than it is now conducted, without the use of a machine system.

Twenty years ago the highest average of transmission over a single wire was, by the quadruplex system, about fifty words per minute; the telephone was only thought of for local use over distances of a few miles. Now it is practicable to telegraph 2,500 words a minute between Washington and New York, and 1,000 words a minute between New York and Chicago, while the telephone carries speech 1,500 miles.

The Wheatstone system has an average of about 150 words a minute. The English Wheatstone system is used between New York and Chicago. The average by hand is about fifty words a minute. In view of what has already been done, I do not think that any telegraph electrician will dissent from these propositions: That with machine transmission and chemical recording by the method referred to, over a copper wire weighing 850 pounds to the mile, and with an ordinary current power such as is used for quadruplex working, 1,000 words per minute can be plainly recorded over a distance of 1,000 miles, or, say, from New York to Chicago, and that over such a line 2,500 words per minute can be plainly recorded from New York to Washington and between other points throughout the country in the same ratio, according to distance. Last October, over an actual line, having but 130 pounds of copper to the mile (Philadelphia to Harrisburg and return), 216 miles, 940 words per minute were plainly recorded in dots and dashes, the current used being but 120 volts. This trial was conducted in the presence of a board of well-known electrical experts. With this system 8,000 words per minute have been recorded over an experimental line.

Here Dr. Delaney submitted estimates of cost and earnings of a line of two 1 ohm per mile copper wires between New York and Chicago operated at 1,000 words per minute.

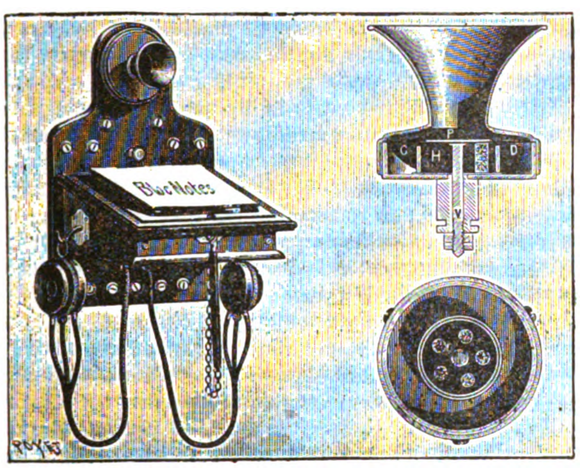
I think generally, with reference to my experience in regard to this matter, that $25,000,000 applied to wires such as I have described in this statement would give greater facilities for carrying telegraph dispatches in this country than is now furnished by the wires of the Western Union Telegraph Company. It might not reach all the small offices now reached by

[1] Abstract of Argument before U. S. Senate Committee.

the Western Union Telegraph Company, but it would cover the large points which would take more than three-fourths of the traffic. I am unable to understand why Congress has not long ago authorized the Postmaster General to fix a maximum rate for telegraphic letters, and contract with the lowest bidders for their transmission, especially between cities separated by any considerable distance.

THE BLOC-NOTES TELEPHONE.

We illustrate in the accompanying engraving the "Bloc-Notes" telephone, which is shown complete at the left-hand side of the engraving, and also the microphone which is shown in detail. This belongs to the granular carbon class of instruments and is composed of a small carbon cylinder, H, which is perforated by five channels filled with granular carbon. This cylinder is insulated from the metallic case forming its exterior envelope by a sheet of mica. A strong screw, v, provided with two nuts, fastens the cylinder against the bottom of the box. The vibrating plate, CD, of very thin carbon, is held in place by the outside cover to which the speaking trumpet is attached. This plate is then adjusted in such a manner as to be in contact with the granules of carbon contained in the holes of the cylinder, while the latter, on the contrary is insulated from the plate.



THE "BLOC-NOTES" TELEPHONE SET.

With the apparatus thus constructed the current enters by the screw, V, and passes by way of the cylinder, the granules, the vibrating plate, and goes out through the body of the metallic case.

The packing of the granules cannot take place. It is very easy to displace them and to give the microphone its original sensitiveness by simply turning the apparatus around upon its axis. The dismounting is done with equal facility.

It remains to mention the receivers, which are very light. They weigh scarcely 180 grammes. Each is fixed by a special attachment independent of the conductors, which are thus relieved of all strain.

Models of this instrument have been in use in the Central Telephone Exchange, in Paris, for three years, where they have given excellent service.

DIFFICULTIES OF CHINESE TELEGRAPHY.

According to the "Statesman's Year Book," all the principal cities of China are now connected with one another and with Pekin, the capital, by telegraph. Recent visitors to China say, however, that telegraphing there is a laborious and an expensive process.

The Chinese have no alphabet, and their literary characters number many thousands, so it is simply impossible to invent sufficient signals to cover the written language. This difficulty was obviated by inventing a telegraphic signal for each of the cardinal numbers, and so numbers or figures might be telegraphed to any extent. Then a code dictionary was prepared, in which each number from 1 up to several thousands stood for a particular Chinese letter or ideograph. It is, in fact, a cipher system. The sender of the message need not bother himself about its meaning.

It is very different with the receiver. He has the code dictionary at his elbow, and after each message is received he must translate it, writing each literary character in place of the numeral that stands for it. Only about an eighth of the words in the written language appear in the code, but there are enough of them for all practical purposes.

Men of ordinary education have not sufficient acquaintance with the written language to be competent telegraph receivers, and the literati are not seeking employment in telegraph offices any more than our college professors are. So the government recruits its employés with much difficulty.

There is another great disadvantage in the Chinese telegraph system. All over the world the movement of railroad trains are regulated by telegraph. Railroads have been introduced into China to a very small extent, and there is talk of greatly extending the service. But how about running the trains?

The Chinese Government will not take foreigners into its service, and the educated men of China, who alone among the people have sufficient knowledge of the written language to be intrusted with the actual running of trains, would refuse most emphatically to be either train hands or station agents.

THE OFFICIAL CABLE CODE NOT COMPULSORY.

The International Telegraphic Convention sitting at Budapest has finally decided not to compel the use of the official vocabulary for cablegrams in code to and from countries beyond Europe, known as extra-European business, in which, of course, is included the United States.

Protest against the compulsory use of the vocabulary was made by the representatives of the British Government, supported by similar protests from various commercial exchanges of the United Kingdom and of the United States, presented by representatives of the transatlantic cable companies. This result was brought about by the joint movement of the interested telegraphic administrations and companies.

ASSESSMENT OF THE N. Y. AND N. J. TELEPHONE CO.

The application of the New York and New Jersey Telephone Company for a reduction of the assessment valuation of its personality was considered last week by the Brooklyn, N. Y. Board of Assessment and Assistant Corporation Counsel Rollin C. Breckinridge. The valuation has been fixed by the Board at $641,000 and the company claims that it should be reduced to $387,000. Henry Sanger Snow, treasurer of the company, submitted statements in support of the application. The company strikes out from its taxable assets $845,000 invested in patents; $307,000 of capital stock not paid in on May 30. It includes in its debts accrued taxes including the expenses of the subway commission. It includes in the debts certain trust funds, dividends deposited in trust, and also an item of several thousands of dollars to the credit of an unknown stockholder. It seems that there are some shares of stock which have been sold, but the owner is not to be found, and the company has deposited in a trust fund the moneys and dividends upon the stock, and deducted them as a debt. Those items are not included in the gross assets.

THE INTERSTATE LOCAL TELEPHONE ASSOCIATION.

This association now includes in its membership a network of exchanges in West Virginia, eastern Ohio and western Pennsylvania, twenty-five in number, with about 15,000 instruments and subscribers. These towns have been admitted to membership: Youngstown, O.; Sistersville, W. Va.; Richmond, Va.; Indiana, Pa.; Steubenville, O.; Greensburg, Pa.; Apollo, Pa.; Zanesville, O.; Altoona, Pa.; McKeesport, Pa.; Carnegie, Pa.; Braddock, Pa.; Johnstown, Pa.; Latrobe, Pa.; Blairsville, Pa.; Mercer, Pa.; Wheeling, W. Va.; Newark, O.; Barnesville, O.; Bellaire, O.; Fairmont, W. Va.; Mannington, W. Va.; Grafton, W. Va.; Wellsburg, W. Va.; Martin's Ferry, O.; Bridgeport, O.; Pittsburgh, Pa.; Allegheny, Pa. The last meeting of the ways and means committee was well attended and all the members of the committee were enthusiastic for success.

The McKeesport company has been in operation since 1890, has made a 50 per cent. cut in the rates that prevailed before, and is paying a dividend of 20 per cent. Last week the Youngstown company ordered 500 additional telephones; it will make a 42 per cent. reduction in existing rates in the Ohio town, and expects to be able to pay a 25 per cent. dividend. The independent company organizing in Pittsburgh expects to start with 500 telephones.

THE

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CONTENTS.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The report of the meeting of the Northwestern Electrical Association, which we print in this issue, is most gratifying evidence of the vitality of that association, and more particularly of the necessity of similar associations in every State of the Union. The unscionable work of so-called "parent companies," whose actions have in the past been anything but of a parental nature, have long since forced upon local companies the necessity of protecting themselves from unwarranted competition, and latterly the municipal plant craze has well-nigh filled to the brim their cup of bitterness. It is just such local associations as the Northwestern that can by the gathering of statistics and intelligent co-operation of its associated companies prevent the establishment of competing municipal plants. It will require, indeed, a hard campaign of education to counteract the present populistic tendencies, but we are convinced that sufficient material is already at hand to make such a campaign effective. At this convention Mr. Beggs again inveighed broadly against the usefulness of the National Electric Light Association, if anything, more strongly than he did at the late meeting in New York. We do not at all agree with Mr. Beggs' views in this respect. The N. E. L. A. has a mission quite as useful and far broader than any mere local organization can fullfil. We need only cite as a single instance its "Wiring Rules," which have become the model on which the rules of the National Board of Fire Underwriters are based, and which, indeed, they have appropriated almost bodily, albeit without due credit. No local organization or any number of them could have accomplished this work, of such enormous import to all local companies. As to some of Mr. Beggs' individual criticisms, they are not to be laid at the door of the Association, as such, but to its management. Possibly more good could have been done in the past if the officers and committees appointed for the purpose had given more of their time to the business of the association. We believe, however, that this remissness has been recognized, and that henceforward a more active participation in the work of the Association will be noticeable on the part of those responsible for its management. It would,indeed, be a pity if an organization embracing representative companies over the entire Union should have lost its reason for existence after having performed yeoman service in welding together many heretofore conflicting interests, and by its very presence acting as a check to many threatened aggressions of the "parent companies" in the past. By all means let the organization of State associations continue, but let the National Electric Light Association continue as the mentor, and, as it were, the clearing house of them all.

GOVERNMENT TELEGRAPHY.

NATIONAL legislatures throughout the world generally have some sort of perennial proposition to deal with—something that is always downed, but never dies. In England it has long been the "Deceased Wife's Sister" act; with us it is postal telegraphy. One is opposed by the bishops for no apparent good reason, the other by the life peers of existing enterprises from motives that are plain enough. But while the sister-in-law measure was fought out in the upper house with great earnestness, every year, and has at last been crowned with success the blessings of postal telegraphy have, with one or two exceptions, been but lukewarmly supported in either branch of Congress. Postal telegraphy has been vicissitudinous from the very beginning, when Cave Johnson in the House of Representatives, in 1843, met the proposal for an appropriation of $30,000 in aid of Morse's patent, by an amendment providing that half the amount asked for should be spent in the investigation of mesmerism, and no better evidence of the early tendency of postal telegraphy to mutative traits could be wished for than was afforded by this fine old scoffer, when, as Postmaster General, a few years later, he made a most vigor-

ous protest against the transfer of the few miles of line then in operation from government to private control. Reference to a few extracts from an argument by Mr. Patrick B. Delany, before the Senate committee on post offices and postroads, just prior to the adjournment of Congress, which we print on another page, may not convince everybody of the soundness of State paternalism which it is proposed to apply to telegraphy, but there can be no doubt that this question has been lifted out of its usual state of flabby inanition and has taken a new lease of life which promises to keep it in the front rank of activity until it is permanently disposed of, one way or the other. In a few words, Mr. Delany has foreshadowed more discomfort and worry for telegraph and telephone interests than all the academic platitudes of previous impractical advocates of postal telegraphy. Mr. Delany says he cannot understand why Congress should not authorize the Postmaster General to fix a maximum rate for telegraphic letters between cities, and contract for their transmission with the lowest bidder. This is a most disquieting suggestion, entirely out of harmony with the calm security heretofore extractable from the customary request for a large appropriation of money by the government for construction of lines. It is indeed hard to see how goldbug, silverite of populist can find valid objection to a proposition for quickening the mails in the ratio that the speed of electricity bears to that of steam, so long as the price is sufficiently low, and the government is not asked to spend a dollar. Nor is this all the torments hinted at in Mr. Delany's argument. He thinks it would be a good thing to compel telegraph companies to note on each message delivered the time of filing at the place of its origin, as is done in other countries. This must be viewed as the refinement of cussedness by the owners of systems which have guarded this knowledge as a needless requirement and placated public longing for precise detail by marking on each message the time of its arrival. This has enabled the public to keep compassionless tab on the messenger boy in his wanderings, but left to the widest range of speculation any estimate of how long the message has been on the way.

We are no more in favor of government telegraphy than of municipal control of electric lighting stations, but it would be closing one's eyes to patent facts to ignore the force of some of the contentions put forward by Mr. Delany. That the present systems of telegraph and long-distance telephone lines are not worked to anything like their full capacity during the twenty-four hours of the day, is self-evident, and the proposition for the government to contract for their utilization during "light load" hours is one worthy of the most serious consideration. Presented in this way the project has at once removed from it the objections and dangers of a government monopoly and places the telegraph and telephone companies on the same footing as the railroads occupy with respect to the Post Office Department. Far from opposing such a scheme, we see no reason why the telegraph companies should not welcome so large an certain an increase in their present volume of business.

GERMAN CENTRAL STATION STATISTICS.

WE have in the past pointed out the thoroughness of the published statistics on German central stations, from which much useful information may be gleaned. The most recent of these is due to the labors of the "Vereinigung der Vertreter von Elektricitätswerken," an organization composed of the representatives of central stations. These statistics, although they cover only thirty-six stations, are nevertheless of more than usual interest, as they cover details not touched on in any others of like nature which have come under our notice, due, no doubt, to the minute care bestowed on them and their absolute trustworthiness. Of the thirty-six stations embraced in the statistics, eighteen are under municipal management. Considering conditions in Germany, where the tendency toward government control is very strong, this is not a very high figure. The prices at which light and power is furnished vary widely. To private customers the figures range from 8¾ to 22 cents per kilowatt hour, while current for power is furnished from 4½ to 10 cents per kilowatt hour. These figures, which are higher than those in the United States, are of still greater importance, considering the fact that 10 cents in Germany go a great deal further than they do here, in most cases. The reason probably lies in the greater economy with which the Germans utilize their circuits. To illustrate our meaning we may take the case of the Edison Illuminating Company, in New York City. Reducing their entire system of incandescent lamps, arc lamps and motor service to a basis of incandescent lamps, this company have an equivalent of 485,000 lamps on their system. The average utilization of this entire number is about 1½ hours per day. If all their customers were more economical, possibly as economical as the Europeans—where the load lines at 10 o'clock in the evening show that the majority of the inhabitants have retired or where people find an inherited delight in sitting in the twilight, thus postponing the rise of the load line in the central stations—the average utilization of the New York Edison Company's current would probably go not much above one hour. In that case, the prices would necessarily have to be higher, since the fixed charges would not change appreciably.

Twenty-five out of the thirty-six stations have accumulator plants in connection with their system, an enormous percentage from our point of view, especially in view of the fact that seven of the remaining plants utilize alternating current. The total number of cells installed is 6,780, with 63 cells as the lowest and 544 cells the highest number in any one station. The total capacity of these in kilowatt hours is 13,509 with 475 kilowatt hours capacity in the smallest, and 1,746 kilowatt hours in the largest installation.

The number of customers supplied in twenty-eight out of the thirty-six cities is 11,644, in which Vienna with 2,708 is included.

One table gives the losses in accumulators, transformers and network in per cent. per year, some of which are worth noting. In one town, Neuhaldensleben, the total losses are 40 per cent., 20 per cent. being in the accumulators. It has a three-wire system, with distribution on wood on poles. One hundred and thirty-four storage cells are installed in this station, with a capacity of 101 kilowatt hours and two shunt dynamos, with 76 kilowatt capacity, as generators. The total number of customers is 128, using 2,900 incandescent and 36 arc lamps. The average utilization per kilowatt is 28 hours per year. Comparing this with the station showing the smallest losses: Elberfeld, with a three-wire system with iron armored cables laid underground, has no accumulators, but twelve dynamos with a total capacity of 660 kilowatts. The average utilization for every kilowatt furnished is forty-nine hours per year. The total number of arc lamps supplied by thirty towns is 20,181, the number of incandescent lamps being 328,913. It is again interesting to compare this latter figure with that of the Edison Illuminating Company in New York, which supplies 240,000 incandescent lamps at the present time. All figures presented thus far appear extremely low as compared with those covering like points in this country, but it should be considered that Berlin is not included in this list. In looking over the data on drop along the mains we find remarkable uniformity. In the three-wire systems the drop varies from 1½to 3 volts per side, while a few stations give figures varying from 2 per cent. to 3 per cent. Another question of preeminent importance is the cost of the feeders and mains in comparison to the current furnished. The weight of the copper varies from 4.95 to 24.7 kilogram per 100 watts, an average of 10.05 kilograms. This applies to the direct current installations. In the alternating current plants the weight of copper is on an average 4.31 kilograms per 100 watts delivered. Finally, the statistics show that one kilogram of coal will supply on an average 271 watt hours, varying from 70 to 493 in the various plants. The average yearly increase for current furnished is over 43 per cent., which shows the constant growth of the German installations.

SOCIETY AND CLUB NOTES.

FOURTH SEMI-ANNUAL CONVENTION OF THE NORTH-WESTERN ELECTRICAL ASSOCIATION, HELD AT MARINETTE, WIS., JULY 15-17, 1895.

THE convention was called to order by the president, Mr. W. B. Baker, of Waupaca, Wis., at the courthouse, at 9 a. m.

The secretary called the roll and the following members answered to their names:

Active Members—W. A. Baker, Waupaca, Wis.; A. O. Baker, Sheboygan, Wis.; W. P. Bragg, Monroe, Wis.; A. C. Bunce, Milwaukee, Wis.; Loren W. Burch, Madison, Wis.; Chas. Cuno, Oconomowoc, Wis.; Ed. Daniel, Menominee, Mich.; Fred DeLand, Chicago, Ill.; G. W. Hanley, Marinette, Wis.; J. H. Harding, La Porte, Ind.; H. C. Higgins, Marinette, Wis.; P. H. Korst, Racine, Wis.; R. F. Kountz, Neillsville, Wis.; I. P. Lord, Waupaca, Wis.; T. R. Mercein, G. S. McLaren and E. G. Mullen, Milwaukee, Wis.; C. C. Paige, Oshkosh, Wis.; G. B. Wheeler, Eau Claire, Wis.; O. B. Williams, Whitewater, Wis.; L. E. Kerns, Madison, Wis.

Associate Members—C. O. Baker, F. N. Boyer, H. D. Latimer, W. W. Low, Geo. Whyte, Chas. E. Wilson and James Wolff, all of Chicago.

Corporation Members—Crouse-Tremain Carbon Company, Fostoria, O.; DePere Electric Light and Power Company, De-Pere, Wis.

PRESIDENT'S ADDRESS.

The president remarked that the benefits derived from the semi-annual convention of central station managers, as well as supply men working under nearly the same conditions, had been felt by all who had attended, and that the association would soon be a power that would be felt beyond their limits. A gentleman recently remarked that while the Northwestern Electrical Association could learn from the National Association, on the other hand, there were many things that their little association could teach its superior.

Within the past month he had received two letters from gentlemen in different parts of the State, asking if the association could not come to their rescue. The situation in one case was this: In one of their cities the only lighting plant in the place was furnishing street lights to the city; the city desired to operate its own plant, but not being in a position where it could bond itself for building the plant, it was attempting to make arrangement with parties, to build a plant and bond it and float the bonds and turn the plant over to the city at a nominal figure of one dollar, subject to the bonds.

The president also suggested that the secretary keep a record of the rates charged in each city within their limits, so that whenever a member desired information regarding rates in other places he had only to write the secretary and obtain the necessary statistics. Reference was also made to the insurance question.

The secretary then read the secretary and treasurer's report.

Mr. Lord, of the legislative committee, reported progress. There had been no session of the legislature since the last meeting; there would be one the coming winter, when they would try to do their duty.

Mr. F. DeLand ,of the programme committee, reported pap rs as follows: "Rights of Electrical Companies," by W. Clyde Jones, of Chicago; "The Insurance of Electrical Plants," by R. H. Pierce, of Chicago; "Insurance," by C. C. Paige, of Oshkosh, and discussion on that subject by Wm. H. Merrill, of Chicago; "The New York Convention and Exposition," by Thos. R. Mercein, of Milwaukee; "Alternating Current Motors," by Prof. D. C. Jackson, of Madison; "Lightning Arresters," by W. R. Garton, of Chicago.

Mr. Paige, chairman of the insurance committee, reported that no meetings of the insurance committee had been held, but that he expected to meet the full committee here, and that they would probably later get up some report and recommendations. He had prepared a short paper on the subject which would recommend some action in that direction.

Mr. Hanley, of the entertainment committee reported on the entertainment provided for the members, including a trolley car trip to Lakeside, a dance at the Oakwood Beach Club, a trip to Menominee and a banquet at the Hotel Marinette.

The committee on reclassification of membership reported that it was not yet ready to present a formal report.

The committee on resolutions submitted drafts of resolutions on the death of Messrs. Hall, Gunderson and Sullivan, which were adopted.

The following applications for membership were presented: Henry L. Doherty, general manager Madison G. & E. Co., Madison, Wis.; H. M. Kellogg, superintendent municipal plant, Adrian, Minn.; Foree Bain, consulting engineer, Chicago; G. E. Fish, Little Rock, Ark.; G. M. Sanborn, electrical contractor, Indianapolis, Ind.; S. E. Christie, traveling salesman Dearborn Drug and Chemical Works, Chicago, residence Racine, Wis.; C. E. Van Bergen, secretary Hartman General Electric Company, Duluth, Minn.; A. A. Cross, general manager Superior Light and Power Company, West Superior; R. J. Randolph, Excelsior Electric Company, Chicago, Ill. The gentlemen named were duly elected.

The paper by Mr. W. Clyde Jones, on "The Rights of Electrical Companies," was read, in the absence of Mr. Jones, by Secretary Mercein.

The paper on "Insurance of Electrical Plants," by R. H. Pierce, was read, in the absence of Mr. Pierce, by Mr. Cutter.

Mr. Merryman, vice-president of the Marinette Electric Light and Street Railway Company, was introduced to the association and inquired as to the feasibility of transmitting energy from different sources varying from three to fifty miles distant.

Mr. John I. Beggs, of Cincinnati, suggested the employment of a competent engineer to determine the question.

He was at the present time unfortunately trying to hold up a plant located by one of the best engineers of this country, where they are considering the advisability of spending a million dollars to build a new plant, notwithstanding the plant in question had only been built five years. There was no excuse for the blunder in wrongly locating this plant; but for the reason that factors which should have been taken into account carefully were not at all considered, they found themselves in this predicament. The engineer looked at the site, thought that would be a good place to install an electric light station, and so they, following his advice, sunk one and one-half millions of dollars! He did not suggest that an engineer tell them whether it was profitable to build the plant—the business man must decide that—but to get the engineer to make the calculations as to the cost of copper, how much one would lose in transmission, etc., questions of that kind; then they should apply his calculations commercially. The technical part was the least part, yet it was very essential.

Before adjourning the president invited all to look over the articles exhibited by the electrical supply men in an adjoining room. The president also stated that he had had handed to him a list of twenty-eight towns in the State of Illinois, giving their population, number of lamps used and other statistics.

Mr. DeLand referred to the work compiled by Mr. W. J. Buckley, honorary member of the Northwestern Electrical Association, the subject of which book is electric lighting plants. This book showed the prices up to a year ago. A new edition was now being gotten out which would show rates to the beginning of the present year.

Mr. Kountz thought that the information in the book would not be entirely satisfactory to them, because the cities were located all over the Union, while the association was composed mainly of men in Wisconsin, Michigan and contiguous territory. He should like to get information particularly regarding their own territory, especially Wisconsin.

A suggestion was made that traveling salesmen could assist in obtaining this information if they were furnished with blanks, and that they could without much trouble to themselves obtain statistics which were desirable from the plants as they visited them on other business.

Mr. DeLand offered to present a copy of Mr. Buckley's book to the secretary.

Adjourned to meet at the same place Thursday, July 16, 1896.

THURSDAY'S PROCEEDINGS.

The president called the meeting to order and Mr. Hanley offered a motion covering penalties for non-payment of dues. Five new members were also elected.

A paper was then read by Mr. Mercein on the subject of the New York N. E. L. A. Convention and exposition, which was received with great applause.

The next paper read was that on "Alternating Current Motors," by Prof. D. C. Jackson, of Madison, read by Mr. Cutter.

Mr. J. I. Beggs, being called on to discuss Mr. Mercein's report on the N. E. L. A. meeting, said that he had challenged the National Electric Light Association to show a single thing that they had ever done for the benefit of central stations; he still held that challenge open. If the central stations of this country would stand united together, there would not be so much effort made by the representatives of manufacturing companies to exploit municipal plants. The first seeds in these cases were usually sown by some over-zealous representative of some manufacturing company producing apparatus. (Ap-

plause.) He defied any man throughout all this Northwest to say that the Edison General Electric Company under his management ever attempted for the purpose of selling apparatus to exploit an opposition company. He did not know of a single thing that was done by the National Electric Light Association at its recent session in New York City, that would interest any representative of a local central station here or anywhere else in the United States. Most of the papers read, as Mr. Mercein had well said, were too technical and too high flown for practical application. What was wanted was the practical talk of men who were dealing with conditions as they arose day in and day out.

"I have come here at great personal inconvenience, and it has taken two days for me to reach here, because, in the first place, I was very much interested and pleased with your annual meeting that I was fortunate enough to be able to attend in Milwaukee six months ago, and I was so much impressed with the earnestness of this association and the work that it was capable of doing, and in the second place because of my interest in central station business. As you know, I have had experience on both sides, and still have, yet I do not hesitate, no matter with whom I may come in conflict, to say that we should stand together to show to manufacturers of apparatus that their interests lie in allying themselves with central station people."

Mr. Beggs stated that they had passed very strong resolutions in the Ohio State Association, pledging the members of that association to discriminate against any concern interested in exploiting an opposition plant in the territory of any central station lighting company. (Great applause.) Scarcely any of the resolutions passed by the National Electric Light Association, he said, amounted to anything, because the membership of that association was too meager and unrepresentative. They represented a few large companies in a few large cities, but the large companies in the large cities are in many instances controlled by the very people that are interested in exploiting this apparatus; but it is the hundreds of small companies all over this country that can make themselves felt and should make themselves felt. Therefore, he suggested the passage of resolutions by all these local associations to the effect stated. Mr. Beggs advocated the gathering of statistics for the State of Wisconsin, and their careful sifting to avoid the drawing of false conclusions. He referred in complimentary terms to Mr. Ferguson's paper on "Acetylene," read before the N. E. L. A. at New York. He advised following the example of the Association of Edison Illuminating companies, namely, to crowd all business into, say, the first two days, having two sessions a day, instead of one, using the evening and all of the third day, if desired, for entertainment purposes.

Mr. Beggs said that those operating unprofitable stations should not despair. When he took hold of his present station, two years ago, at Cincinnati, it was losing $2,000 a month. It was now earning $7,000 a month.

Mr. Debell referred to his experience in Sheboygan, where he nearly lost a city contract on false figures as to the cost in another town.

The president thanked Mr. Beggs on behalf of the society for his remarks.

Mr. W. R. Garton's paper on "Lightning Arresters" was then read.

Mr. Schuette feared that an attempt would be made to repeal the law which prevented cities from building their own municipal plants if there were another plant offered for sale, and he believed it would be well to notify all electric plants to join in the next meeting to arrange to be represented at Madison all the time to guard their interests.

Mr. Beggs thought it advisable for the local companies to form a very close union, but certainly it would be injudicious, unbusiness-like and improper, not to say offensive, to institute or make any attempt at instituting a boycott of manufacturers entering territory already occupied. But the number of large manufacturers with whom they dealt was small, not to exceed five or six, and there were not so many sprouting up as there used to be, because there was not the great amount of money in the business that there formerly was, and the price at which apparatus was now obtained was not such as to invite manufacturing companies to enter a town as they formerly used to, put in some apparatus, take one-half of the price in bonds and the other half in cash. In regard to the prices charged for lights, he did not think it was very difficult to-day to demonstrate to almost any municipality that the price at which they were willing to render them service was about as low as they could possibly render it themselves, and in many instances it was much lower. The price of electric lighting had now gotten down, as a general rule, throughout the country, to between $80 and $90 for a 2,000 candle-power lamp, burning all the dark hours (not a moonlight schedule). His idea was not to urge upon the association to adopt the method of meeting competing manufacturers, in any offensive way, but if they understood that the companies were dormant the manufacturers were ready to take advantage of their position; but if a manufacturer knew that fifty or sixty companies were standing together to prevent their business being injured, this very fact would prevent in all probability his entering into competition with them.

Mr. Beggs added that they must be careful not to enter into any competition which would have a tendency to demoralize prices, such as is now being attempted to be done in Columbus, in order to get a city contract. He thought one of the fairest operated municipal plants ever put up in this country, the one in which the statistics have been more reliable, more accurately kept and all the factors taken into account in the fairest manner, is the plant located in the city of Detroit, operated by the municipal government there. As a matter of fact, very few of those present were getting as much for an arc lamp as it was costing the city of Detroit to-day. According to Mr. Dow's very accurate and systematic statistics, it is shown that it is costing the city of Detroit nearly $90 per lamp per annum to run their plant. Statistics of that kind taken around, freely disseminated, would show the fallacies of exploiters of apparatus.

The central station people of this country, continued Mr. Beggs, were far more powerful to-day than the manufacturing companies. The electric lighting stations of this country had within themselves all the elements necessary to manufacture their own apparatus if they were provoked to it, and if provoked they would do their own manufacturing. (Applause.) Some years ago when this opposition selling was being done to a greater extent than now, by manufacturers, there was $8,000,000 of capital pledged by lighting companies to manufacture apparatus.

"These manufacturers well know our power," said Mr. Beggs. "There are few manufacturers of electric apparatus to-day that are not bankrupt, particularly the large ones, and I say it with all due respect. The two largest manufacturing combinations in the United States are bankrupts to-day. On the other hand, most of the electric lighting companies in this country are not only not bankrupt, but they are making a fair return upon their investment, and we have it in our hands, gentlemen, to say to these people what is fair business practice, and to require them to recognize fair business principles, in dealing with us who have been their customers during all the years of their business. I do not mean to carry this plan out in any offensive way, but you can accomplish a great deal by moral suasion when you know you are backed up by reason, good judgment and ample capital. There is ten times more capital represented in our local companies than in manufacturing companies. In fact, the manufacturers are dependent upon us, we are not dependent upon them. (Applause.) The sooner that position is taken and understood by the central station people, the sooner we will get that respect paid to us to which we are entitled (Applause.) There is to-day so little difference between standard apparatus of various makers, that it is hard to tell which is preferable. Standard apparatus is also more easily purchasable now than formerly; bonds and licenses have become relaxed, and all that it is necessary for us to do is to stand firmly together."

Mr. Beggs stated that the Association of Edison Illuminating Companies had forced the largest manufacturer of incandescent lamps in this country to admit now that they did not know what they had been producing; that they had not been getting one-half the effective light that was guaranteed; they were now laying down the conditions under which they shall manufacture lamps for them.

Their demand was for "constant economy," allowing a variation of 10 per cent. on candle-power, which meant that the lamp may be 17.6 candle-power or 14.4 candle-power, but the watts and voltage must be constant. Most Edison licensees were running 3.1 watt lamps, and were making a demand for a 2½ watt lamp, because a 20 candle-power lamp was needed to-day to compete with the present status of gas and the Welsbach burner, and they needed a 20 candle-power lamp without any increase in the cost of production or to the consumer. He considered the 4 watt lamp a monstrosity. They would guarantee a large output of lamps to the company that could give them a 2½ watt lamp that will last 300 hours standing up under a candle-power of from 12.2 to 20; but there was not a lamp manufacturer in the country that dared to take up that proposition.

Mr. Buckley stated that the question of a 2½ watt lamp was brought up especially because every lamp manufacturer spoken to regarding the lamp, invariably and strenuously insisted that the lamp could not be made. It was simply a question whether central station men would use and burn lamps which these large manufacturers made a considerable profit on, or whether they would gather themselves together, increase their investment, and make a lamp on which a profit could be made.

Manufacturers claimed that such a lamp costs from 3 to 5 cents more to make. The companies coud afford to pay more for such lamps, though they did not want to do it.

Mr. Beggs suggested that for each 5 per cent. that the lamp falls below standard there should be 10 per cent. deducted from the price of the lamp. In his specifications he provided that if the lamp was 10 per cent. higher that the specifications, he would pay 5 per cent. more for it, and so on up until it reached 100 per cent. more than the specifications required, when he would pay 50 per cent. more. Mr. Edison was at the present time working on a very high voltage lamp. It was a very difficult thing to produce, but he had never known anything in this business that was absolutely required that was not forthcoming. He expected the 2½ watt lamp within the next two years.

The report of the Committee on Ways and Means was next read, and its principal reference was in regard to the payment of a special indebtedness to Mr. Lord incurred on behalf of the Association.

Mr. Low moved that steps be taken by contribution and subscription to liquidate the debt of the Association, and a considerable amount was subscribed at once by representatives of a number of central stations.

Adjournment was then taken to 2 p. m.

At 2 p. m. the convention was called to order by the president, and a paper on "Insurance," by Mr. C. C. Paige, was read. A long discussion followed by Messrs. Paige, Wheeler, Kountz and Cuno, in which it was brought out that the worst trouble to contend with regarding insurance rules in wiring was the constant change.

The report of the special committee to consider the recommendations in the president's report was then read by the chairman, Mr. Doherty.

Mr. Harding then related the experience of the Logansport company, where, in order to kill the competition of the company, the city, which had installed a plant, chopped down the company's poles.

A motion was then carried that the thanks of the Northwestern Electrical Association be tendered to the entertainment committee consisting of Messrs. Higgins, Hanley and Daniels, and through them to the good people of Marinette and Menominee for the courtesy and generous hospitality which had been extended to the members of this convention during the present session.

A number of applications for membership were then presented and granted.

The meeting then adjourned to 9 o'clock July 17, 1896.

FRIDAY'S SESSION.

The Chair called the meting to order Friday morning and appointed a committee for solicitation of new membership.

After transacting some routine business Mr. Kountz moved that the legislative committee be discontinued, and that a committee be appointed to be known as the Protection Committee. Carried.

The convention then adjourned sine die.

CONVENTION NOTES.

On Tuesday, July 14, at 10:30 p. m., a considerable contingent of the delegates and others arrived in the special car on the Chicago and Northwestern Railway, which left Chicago at 3 p. m. that day, and picked up additional members at Milwaukee and other places en route. The journey was most enjoyable.

On Wednesday a large party of the visiting delegates were taken by electric cars to Lakeside, a beautiful pleasure resort on Green Bay, some three miles from Marinette. Here various sports in the shape of log rolling, tub races, boating, and foot races were indulged in. In the evening a large number of the visitors were again taken to Lakeside and into the grounds of the Oakwood Beach Club, where a large dancing party, composed of the most prominent people of the twin cities of Marinette and Menominee, were assembled to entertain the visitors, which they did right royally.

At 3 p. m. on Thursday a train of three electric cars on the Marinette line conveyed a considerable number of the visitors as far as the line separating the two cities, when a change was made to President Daniell's road, the Menominee Street Railway. The party were taken to the Scaling Gap, a short distance outside of the city, where they made a stop of some time and watched with considerable interest the marking of the logs as they passed the gap down the river to the sawmills. The Leisen & Henes brewery was then called at, where the visitors were shown through by Mr. Henes, each one receiving a good sample of the excellent brew.

The same evening at 9:30 a banquet was given at the Hotel Marinette to the delegates by prominent citizens of the two cities. The menu was most excellent, and the floral decorations were also of a very elaborate character, to which was added an excellent orchestra. At the conclusion of the banquet several fine addresses were delivered in response to toasts. Among the most notable were "Marinette," Mayor J. J. Sherman; "Menominee," Mayor J. W. Wells;" "Our Retainers," Lawyer E. C. Eastman; "The Northwestern Electrical Association," President Baker; "The Ladies; Why Should They Be Absent?" Mr. Thos. Mercein; "The Electrical Press," F. L. Perry, and several others.

Mr. George W. Hanley, secretary of the Marinette Electric Light and Street Railway Company, acted as toastmaster in a most able manner. Between the speeches some vocal selections, which largely contributed to the pleasure of the occasion, were rendered by Mrs. H. E. Tanner, Miss Sullivan McGilan, Mrs. Clarke, of Menominee, and Mr. Geo. W. Taylor.

Friday, the third day, was devoted to visiting the paper and sawmills in the vicinity, and also a pleasant sail was taken in Mr. E. C. Eastman's yacht.

So ended the fourth semi-annual convention of the Northwestern Electrical Association, which will long be remembered as the most successful and pleasant held since its birth in the same city of Marinette, when one of the hospitable entertainers, Mr. H. C. Higgins, was elected first president.

It is worthy of special mention that with the exception of the ride over the Menominee line, the entire expense of the entertainments provided was borne by the Marinette Railroad Company.

EXHIBITS.

Mr. Jas. H. McGill, who is quite a prominent figure at conventions, showed a line of samples of street railway supplies manufactured by the Ohio Brass Company, of Mansfield, O., and also some of the goods of the Akron Insulator and Marble Company, Akron, O.

Mr. George Whyte, secretary of the Lescher-Macomber Whyte Company, Chicago, was conspicuous among those who were out to have a good time, and also kept his weather eye open for business.

The Sunbeam Lamp Company, Chicago, showed a nice line of their well-known incandescent lamps.

The Cutter Electric Manufacturing Company had on hand on of the I. T. E. automatic circuit breakers, which was examined by several of the delegates with considerable interest.

The Lakon Company, Elkhart, Ind., were also on deck with matter pertaining to transformers.

Mr. L. W. Burch, of the People's Electric Company, Madison, Wis., was around lively as a bee expatiating upon the many advantages to be gained by purchasing Northern Electrical apparatus, Standard telephones, "Raven Core" wire and the many other specialties carried by this young and progressive concern.

Mr. Jos. M. Hill, Chicago, was also to the fore, as usual, talking Columbia lamps and Wagner transformers.

Messrs. Fred De Land, W. P. Sullivan, F. L. Perry and J. O. S. Church were the representatives of the electrical press present.

The interests of the Anchor Electric Company, Boston, were ably taken care of by their Western manager, Mr. C. O. Baker.

Mr. George Cutter, a familiar figure at such gatherings, was around, and had some of his specialties on view.

Mr. Franklin H. Brown, of the DeWitt-Brown Cedar Company, Menominee, Mich., was also around, and distributed his company's circulars.

The K. McLennan Company, Chicago, made a liberal distribution of matter bearing on Gale's Commutator compound, of which they are the manufacturers.

The Dearborn Drug and Chemical Works, Chicago, gave souvenirs of perfumed envelope sachets and pencils. Mr. S. E. Christie represented them.

Mr. W. A. Dennis, of the Paul Perrizo, Jr., Cedar and Lumber Co., Marinette, was around, and helped materially to make things enjoyable for the visitors.

The Crouse-Tremaine Carbon Co., Fostoria, O., were represented by Mr. L. C. Anderson.

The Central Electric Company, Chicago, had Mr. H. D. Latimer on hand to look after their interests.

The General Electric Company were ably represented by Messrs. A. C. Bunce, F. N. Boyer and P. A. Clisdell, who were prominent figures during the convention.

The Electric Appliance Company were to the fore, as usual, and showed an exhibit of Shaefer transformers and meters and other electrical devices. The worthy president, Mr. W. W. Low, was hustling around as usual, and contributed more than his share to the success of the occasion, being at the same time very ably assisted by his active lieutenant, Mr. W. Wilson.

The Fort Wayne Electric Corporation had their usual hospitable exhibit of a nature suited to refresh the inner man, and Room E, Hotel Marinette, received quite a good share of attention from the delegates and others present. Mr. W. J.

Buckley and Mr. C. E. Wilson dispensed the hospitalities in a most commendable manner.

The New York Insulated Wire Company were represented by their genial Chicago manager, James Wolff. To say that Mr. Wolff kept things a-humming would be only an inadequate description of the part he took in making things a great success on this very enjoyable occasion.

Others who had representatives present included the Chicago General Fixture Company, L. W. Kittman; Julius Andrae & Sons, Milwaukee, Herman Andrae; Wilson-Clark Co., Milwaukee, E. G. Mullen; Henry L. Doherty, general manager Madison Gas and Electric Co., Madison, Wis.; the Milwaukee Board of Underwriters, Geo. S. McLaren, electrician; Hudson Jones; W. R. Fairchild, city editor of the "North Star," Marinette; E. W. Leroy, city editor of the "Daily Eagle," Marinette.

ROENTGEN RAYS.

APPLICATION OF PHOTOGRAPHY BY ROENTGEN RAYS TO ANALYTICAL RESEARCHES ON VEGETABLE MATTER.

BY FERNAND RAMVEZ.

Photography by means of the X-rays can render precious services in analytical research, and especially in the analysis of vegetable articles of food, where it will detect certain of the most frequent falsifications—those effected by the addition of mineral substances.

This method offers manifold advantages; it requires only small quantities of the substances; it leaves the specimens completely intact; it allows us to effect in a very short time a great number of examinations (about a quarter of an hour sufficing for a series of specimens). Lastly, the proof obtained is a piece of convictive evidence quickly demonstrated, easily understood even by persons strangers to any analytical operation.

The experiments which I have made refer to three samples of falsified saffron, taken in trade. These products consisted of mixtures in different proportions of pure saffron and saffron coated with barium sulphate. The filaments of the latter were found surrounded with a shell of mineral matter. The adulteration was very skillfully masked, and could not be suspected on a mere inspection of the merchandise.

I arranged on one and the same sensitive plate, inclosed in black paper, quantities of the three adulterated samples almost equal. No. II. contains 62.13 per cent. of mineral matters, No. III. 28.69 per cent., No. IV., 22.21 per cent., and along with them a specimen of pure saffron. The whole was submitted for three minutes to the influence of the rays emanating from a Crookes tube.

The pure allowed itself to be traversed by the X-rays and produced on the proof merely shadows scarcely visible, not acting, so to say, upon the paper of the positive proofs. The three falsified samples acted strongly upon the sensitive plate, marking very distinctly the filaments coated with barium sulphate, while the stigmati of the pure product, which were mixed with it, appeared only as scarcely perceptible shadows analogous to those of the former product.

The photographic proofs which accompany this note show the distinctness of the results obtained, and enable us to foresee the services which this method will render in its future applications.—Comptes Rendus.

ACTION OF X-RAYS ON HIGHER ANIMALS.

The action of Röntgen and other rays on the higher animals has been studied by Professor Stefano Capranica (Atti R. Accad. dei Lincei). The subject selected for observation was Mus musculus, and the experiments referred chiefly to the quantity of carbon dioxide exhaled in the process of respiration. Professor Capranica states the following conclusions: (1) The amount of CO_2 is the same in darkness as in diffuse daylight. (2) The respiration of Mus musculus is greatly affected by strong sunlight, even when all heat rays have been screened off; and the effect is the same for rays from all parts of the spectrum. (3) Artificial lights, such as the electric light or incandescent gas, act like sunshine when concentrated on the animals, but have no effect when merely used to light a room. (4) The light from Geissler's tubes has no effect. (5) Röntgen rays have no action on the quantity of CO_2 eliminated from the animal, whatever be the condition of the latter; that is, whether fasting or after feeding, whether previously kept for several hours in darkness, or vice versa. (6) What was observed with each of the six moles experimented on was strong excitement, which continued for several hours after the experiments with Röntgen rays had ceased. The moles, after being exposed to Röntgen rays for one hour, ran about in a nervous and excited way, and would not eat. (7) This excitement Professor Capranica attributes to the electrical effects of the Röntgen rays. (8) Experiments on cold-blooded animals (Coronella) give, as yet, no appreciable results.

ON THE DIFFRACTION OF THE ROENTGEN RAYS.

BY L. CALMETTE AND G. T. HUILLIER.

We have the honor of submitting to the Academy some photographic proofs obtained with the Röntgen rays by means of the following arrangement:

Very near the Crookes tube there is a screen, E, of brass perforated by a slit, the width of which has rarely reached a half mm. A second metal screen, E′, is formed of a plate provided with two slits or pierced with a window in which is fixed a metal rod of 1 mm. in diameter. This screen is placed at the distance, a, behind the former. Lastly, a photographic plate, enfolded in two leaves of black paper, is placed at the distance, b, behind the second screen, E′.

The following table indicates, for each proof, what is the screen E′ used, and the value of a and b + a:

No.	E′.	a. Cm.	b + a. Cm.
1.	Rod of 1 mm. in diameter............	5	19.5
3.	" "	5.5	20
5.	" "	8.9	30
7.	Two narrow slits, separated by a cylindrical rod of 1 mm. in diameter....	?	?

On the proofs 1, 3, 5 the shadow thrown by the metallic rod is bordered on each side by a light band which shows a maximum of intensity. Within this shade we observe a zone less dark, which seems to indicate that the Röntgen rays penetrate into the geometrical shadow. Lastly, in proofs 3 and 5 we see, in like manner, a maximum of intensity along the margins of the window in which the rod is placed.

In the proof No. 7 we perceive, in the middle of the two white bands, a fine dark ray, while in the shadow of the rod which separates the two slits there is seen a light ray.

If we compare these results with those obtained with light in the same conditions, the slit being relatively wide and the intensity weak, it seems difficult not to ascribe them to the diffraction of the Röntgen rays.

The proofs obtained in these experiments—which we propose to continue—are not yet so distinct that we can measure the wave length with any precision. But we are still led to believe that this wave length is greater than that of the luminous rays.—Comptes Rendus.

X-RAYS IN CONSUMPTION.

A number of well-known physicians of Chicago have been treating an almost hopeless case of consumption with a direct application of X-rays through the lungs, and although they are not prepared to state positively that the disease has finally found its cure, some of them are forced to the conclusion that the result has been wonderful. One signs his name to the declaration that the effects "so far are but little short of the marvelous." They are all conservative. They speak only of the changes actually recorded and waive final judgment until the patient shall have been subjected to the new discovery for a second period of five weeks.

Prof. H. P. Pratt, who carried on the first experiments with Prof. Hugo Wightman, prepared his electrical apparatus and his special Crookes tubes for the application. The patient, whose face was withered and full of wrinkles, came into the laboratory supported by his mother. His temperature was 103½, pulse 100, respiration 34. His chest was bared, the tube placed in direct contact with the flesh. The exposure was for three hours. At the end there was a decrease of two degrees in temperature, the pulse leaped to 120 and the respiration fell to 22. This record was made in the presence of several physicians, and the boy was allowed to go home with no other remedies than such stimulants as would have been given to all patients under the same circumstances.

With subsequent treatments a continual improvement has taken place during five weeks. Signed statements of the doctors who have attended the treatment of the young man are published in the Chicago "Times-Herald."

AWARDS FOR X-RAYS.

The Natural Research Department of the Animals Institute, London, are offering gold medals and other prizes for improvements in the X-rays to aid the diagnosis of disease and lameness, and for the best developed photographs of the limbs and internal organs of human beings and the lower animals.

LITERATURE.

ELECTRIC LIGHTING. Vol. 1. The Generating Plant. By Francis B. Crocker, E. M., Ph. D. New York: D. Van Nostrand & Co., 1896. 444 pp., 6 x 9. Cloth. Price, $3.

As its sub-title states, this is a work intended for engineers, students and others interested in the installation or operation of electric plants. One is at once relieved on thumbing its pages preliminarily by the absence of all reference to the elementary laws of electricity, which most authors of similar works in the past have considered it their religious duty to inflict upon their readers. Professor Crocker has wisely left that to other books specially devoted to the subject and plunges at once into medias res, after a short introduction and a ten-page chapter on general units and measurements, for which we forgive him in view of his omission of the elementary principles.

In the chapter on classification and selection of electric light systems the author not only gives the usual categorical types of systems now in use, but adds his own comments on the advantages and disadvantages of each, and in this regard we think he has performed a duty from which most other writers have shrunk for fear of giving offence in certain quarters. This chapter is followed by one on location and general arrangement of electric lighting plants, and the buildings required for them, which contains many useful hints for construction of foundations and walls and the methods of driving dynamos.

The possible sources of electrical energy are then taken up, and the various forms discussed. Animal, wind, wave and tide-power, primary batteries, thermo-electric batteries, etc., are passed over with appropriate mention, while naturally more extended space is devoted to the steam and gas engine. The author concludes that so far as the direct generation from coal is concerned, the outlook is not particularly encouraging, and tnat there is no great hope of a radical improvement in this direction in the near future.

We will, therefore, he believes, have to content ourselves with the gradual, but steady improvement of the means which we already have. He does not, however, by any means, give up hope that future discoveries may point to a way of producing electrical energy more cheaply than is possible at the present time.

The importance of the subject warrants the author in devoting a short chapter to the particular consideration of the steam engine and its general principles of operation. The value of this chapter is unquestionable, as it places in strong relief the limitations to which the present type of steam engine is subject, and will place in the hands of many who have hazy ideas on the subject the basic arguments with which to meet the crank, who regularly turns up with devices for increasing steam engine efficiency many hundred per cent.

In the same way steam boilers used for electric lighting come in for their share of consideration, and enough of their principles are given to enable the central station manager to determine whether he is getting the best that can be gotten out of such apparatus. The chapter also contains illustrations of the principal types of boilers now in use, together with accessory apparatus, such as water purifiers, feed-water heaters, fuel economizers, etc. We also notice brief, but comprehensive, paragraphs on steam piping, and the testing of steam boilers, and in the succeeding chapters the author enters more elaborately into the principal types and detailed construction of steam and gas engines, water wheels, windmills, etc., which contain a great deal of useful information in a very small space. The mechanical connections between engines and dynamos then come in for a couple of chapters, in which we find descriptions of the methods of direct coupling, belting, rope driving, tooth and friction gearing, as well as a number of peculiar forms of connection, such as magnetic and hydraulic gearing.

In a book devoted to work which depends upon the dynamo electric machine for its very existence a chapter on the principles and construction of dynamos must necessarily find a place, and the author has, therefore, very properly given an excellent review of the construction of such machines, treating the subject almost exclusively from the practical standpoint. This is followed by a description and illustration of the various types of machines now in general use, and with a chapter on their practical management, which contains a large number of practical hints and wrinkles.

The accumulator, that rapidly increasing adjunct to electric generation and distribution, is next taken up, the principal types being described, together with their management and their application to electric lighting, such as regulators, transformers, and as accumulators to maintain uniform load, etc. While treating this part of the subject dispassionately—as Professor Crocker treats every subject on which he writes—one cannot but feel that he is no friend of the storage battery. Other chapters on switchboards, including switches, fuses, circuit breakers, and on electrical measuring instruments and lighting arresters bring to a close this most excellent volume. We must also note the presence of a good index and numerous references to original sources of information throughout the book.

Most works of the nature of the one before us, in fact, nearly all, without exception, have treated the subject from what might be called the academic standpoint, rather than from the practical; but we are certain that no one could lay down Professor Crocker's book without the satisfying feeling that he had obtained some genuine practical information directly applicable to every-day work. As such we are certain the book will find a genuine welcome, and we hope that the volume to come, which will treat of some of the broader aspects of the subject, among them the financial side of electric lighting, will soon make its appearance.

OBITUARY.

PROF. STOLETOW.

The death is anounced of Professor Alexander G. Stoletow, the well-known Professor of Physics in the University of Moscow. Stoletow was born in 1839, and was educated at the Universities of Moscow, Heidelberg, Göttingen and Berlin, working from 1862-65 in the laboratories of Kirchoff and Weber. He was appointed lecturer in physics in the University of Moscow as far back as 1866, becoming professor in 1873. Professor Stoletow was a member of the first Electrical Congress held in Paris in 1881, and was a member of the jury of the Paris Electrical Exhibition, held in the same year; he was also vice-president of the 1889 Electrical Congress.

Professor Stoletow's chief electrical papers are: "On the General Problem of Electrostatics"; "On the Magnetization Function of Soft Iron," which contained the first explanation of the susceptibility curve; "On a Determination of Maxwell's "v" by the method of repeated discharge of an air condenser of known dimensions; "On Contact Electricity"; "On Kohlrausch's Measurements of the Mercury Unit of Resistance;" "On Actino-Electrical Phenomena," a series of papers on the dispersion of electricity under the action of ultra-violet radiations, and "Ether and Electricity," an address at the meeting of Russian naturalists in 1890.

PERSONAL.

THE RUMFORD MEDAL AWARDED TO EDISON.

In 1885 the American Academy of Science awarded the Rumford premium to Thomas Alva Edison for his investigations in electric lighting, and the presentation of the medal took place at its last meeting. Vice-President Goodale made the presentation speech, which was responded to by Professor Trowbridge on behalf of Mr. Edison, who was unavoidably absent.

THE Albert medal of the Society of Arts has been awarded to Professor David Edward Hughes, F. R. S., "in recognition of the services he has rendered to arts, manufactures, and commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

DETERMINING MERCURY IN ITS ORES.

In the "Journal" of the American Chemical Society there is a short paper in the joint authorship of W. B. Rising and V. Lenher, describing an electrolytic method for determining mercury in cinnabar. The mercuric sulphide is treated with hydrobromic acid, in which it dissolves very readily; the solution is nearly neutralized with caustic potash, pure potassium cyanide added in sufficient excess to redissolve the precipitate which is at first formed, and the solution is electrolyzed by means of a weak current; the operation is carried out in a platinum dish, which acts as the negative electrode, and on this the mercury becomes deposited. The advantage of hydrobromic acid over aqua regia is, that it dissolves cinnabar at low temperatures, so that no loss of mercury by volatilization occurs. Results are given showing the accuracy attainable.

MISCELLANEOUS.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES—II.

BY J. A. FLEMING, M. A., D. SC., F. R. S., M. R. I.

HAVING thus defined our scale of temperature, we proceed to embody the whole of our results in the following tables:

ELECTRICAL RESISTIVITY OF PURE METALS ANNEALED.

Metal.	Resistivity in C. G. S. units at 0 deg. C.	Percentage increment, 0 deg. to 100 deg. C.	Atomic volume.
Silver	1,468	40.0	10.04
Copper	1,561	42.8	7.10
Gold	2,197	37.7	10.04
Aluminum	2,665	43.5	10.56
Magnesium	4,355	38.1	13.76
Zinc	5,751	40.6	9.12
Iron	9,065	62.5	7.10
Cadmium	10,023	41.9	12.96
Palladium	10,219	35.4	9.12
Platinum	10,917	36.69	9.12
Nickel	12,323	62.2	6.94
Tin	13,048	44.0	16.20
Thallium	17,633	39.8	17.20
Lead	20,380	41.1	18.27
Mercury	94,070	—	—
Bismuth	108,000	—	—

ELECTRICAL RESISTIVITY OF ALLOYS.

Alloy.	Composition.	Resistivity in C. G. S. units at 0 deg. C.	Percentage increment, 0 deg. C. to 100 deg. C.
Aluminum-copper	94:6	2,904	38.1
Aluminum-titanium	—	3,887	29.0
Aluminum-silver	94:6	4,641	23.8
Gold-silver	90:10	6,280	12.4
Copper-aluminum	97:3	8,847	8.97
Copper-nickel-aluminum	87:6½:6½	14,912	6.45
Platinum-rhodium	90:10	21,142	14.3
Nickel-iron	95:5	29,452	20.1
German silver	$Cu_6Zn_3Ni_2$	29,982	2.73
Platinum-iridium	Pt_4Ir	30,896	8.22
Platinum-silver	1:2 $PtAg_4$	31,582	2.43
Platinoid	—	41,731	3.1
Manganin	—	46,678	0.
Iron-manganese	88:12	67,148	12.7

These results were embodied in a chart on which the vertical distances represented the resistivity, or specific resistance, and the horizontal distances represented platinum temperatures. The curves thus obtained indicate the manner in which the specific resistance varies with temperature for each substance. The first thing which strikes us is that the lines for the pure metals all converge downward in such a manner as to indicate that their electrical resistance would vanish at the absolute zero of temperature, but that no such convergence is indicated in the case of alloys. We have found that the slightest impurity in a metal changes the position of this resistance line. In the next place, note that the order of conductivity is different at low temperatures to that at ordinary temperatures. At 0 deg. C. pure silver is the best conductor, but at —200 deg. pure copper is better than silver, and the position of mercury is, of course, very different. Again, the lines of some metals are very much curved. The principal magnetic metals, iron and nickel, have lines which are very concave upward, and this is a characteristic apparently of many magnetic alloys. The mean temperature coefficient of these magnetic metals between 0 deg. C. and 100 deg. C. is much larger than that of other metals, and the percentage decrease in resistance in cooling them from + 200 deg. C. to —200 deg. C. is greater than in the case of any other metals.

It is worth noting, in passing, that these magnetic metals, iron and nickel, have smaller atomic volumes than any other metal, and that, generally speaking, the worst conductors amongst the metals are those that have the large atomic volumes and large valency. Next, turning to alloys, we may make mention of a few general facts with regard to their resistance. If to one pure metal we add a small quantity of any other metal, the result is always to raise the resistance line almost parallel to that of the predominant constituent. Thus, in our chart, the alloy consisting of 6 per cent. of copper with 94 per cent. of aluminum is parallel to the aluminum line but higher up. Three per cent. of aluminum added to 97 per cent. of copper yields an alloy with a resistance line parallel to that of copper, also higher up. When two pure metals are alloyed together in various proportions there is generally some proportion in which the resultant alloy has a maximum resistivity, and except in the case of alloys of zinc, tin, lead, and cadmium with each other the resistivity of the alloy is greater than that of either of its constituent metals. In the case of many well-known alloys the proportions which give high, if not the highest, resistivity are those which correspond to definite and possible chemical combinations of the metals with each other—as, for instance, in the well-known platinum silver alloy in proportions 33 to 66, which corresponds in proportion with the combination $PtAg_4$; the iron-nickel alloy in proportion of 80 to 20, which corresponds with the combination $NiFe_4$; the patinum-iridium alloy 80 to 20, which corresponds with the combination $IrPt_4$; and the copper-manganese alloy 70 to 30, which corresponds with the compound Cu_2Mn—all of which are, as far as valency is concerned, possible compounds. It is, however, found that very high resistivity generally involves in alloys a want of tenacity and ductility, and when we reach such limits as 100 microhms per cubic centimetre we begin to find the solid alloys becoming less useful on account of this deterioration of their useful mechanical quality.

We have especially studied the electrical resistance at low temperature of a large series of steel alloys containing varying proportions of nickel, aluminum, chromium, tungsten, and manganese in them. We find that the effect of adding the other elements of the alloy is always to shift up the resistance line nearly parallel to itself, so that the resistance lines of all the iron alloys are nearly parallel to that of the iron line, only the absolute value of all the ordinates is increased. This is equivalent to saying that the effect of the added material is to increase the specific resistance, but not to alter the slope or form of the resistance curve. Amongst these steel alloys there are two or three that are very interesting. A nickel-steel alloy sent to us by Mr. Hadfield containing 19 per cent. of nickel exhibits some very extraordinary properties. Nicket-steel alloys with large percentages of nickel can, as Dr. Hopkinson has shown,[1]

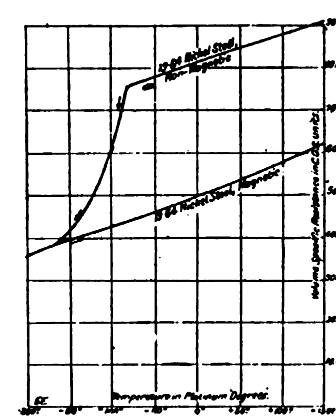


FIG. 6.

exist over wide limits of temperature in two different physical states, in one of which they are strongly magnetic, and in the other of which they are feebly magnetic; and they pass from the non-magnetic to the feebly magnetic on cooling to low temperatures. Here, for instance, is a sample of the 19 per cent. nickel steel in the non-magnetic condition. If it is cooled in liquid air, we can make it pass instantly into a magnetic condition. In the first state it is fairly ductile and plastic, but in the second state it is very hard and brittle. Moreover, its electrical resistance is permanently altered on undergoing this change. In the non-magnetic state it has a high resistivity of about 81,500 C. G. S. units per cubic centimetre at 0 deg. C., but on cooling in liquid air and becoming magnetic it is found to have decreased to about 47,200 C. G. S. units when taken at 0 deg. C. It is perhaps more correct to say that this alloy can exist in an infinity of different physical states, because we have found that the lower it is cooled in temperature the lower its resistivity can be made to be when measured again at ordinary temperatures. On heating up the alloy again to a bright red heat, it goes back into the non-magnetic ductile state.

The chart (Fig. 6) shows how the electrical resistance varies between the limits of —200° C. and 100° C. when the alloy is taken through a cycle of temperature beginning at 100° C. in its non-magnetic state. The 29 per cent. nickel steel exhibits the same characteristics in a less marked degree. A close study of this interesting material shows that there is room for much valuable work upon it yet. A manganese steel brought to notice by Mr. R. A. Hatfield, having about 12 per cent. of manganese in it, is also capable of existing in two states—a magnetic and a practically non-magnetic variety. The magnetic variety, which is much more brittle, is, however, in this case, formed by the prolonged slow heating of the non-magnetic variety out of contact with air. In the non-magnetic condition the material has a very high specific resistance at 0° C.—about 65,700 C. G. S. units per cubic centimetre; but the magnetic variety has a much lower specific resistance, viz., about 51,400 C. G. S. units at 0° C. In all these cases it is

[1] See Proc. Roy. Soc., 1890 Vol. 47. P. 138.

interesting to note that the change of the alloy into the magnetic variety is accompanied by a decrease in resistivity or increase in conductivity; in an increase in brittleness. We have tried cooling this non-magnetic variety of manganese steel in liquid air, but have not been able in that way to make any change in its condition as regards magnetic susceptibility. There is a particular alloy of copper 84 per cent., manganese 12 per cent., and nickel 4 per cent., called manganin, which at ordinary temperature exhibits but little change of resistance with change of temperature. On taking the curve of its resistance over wide ranges of temperature, we find that its curve is very concave downward, and the vertex of the curve lies at

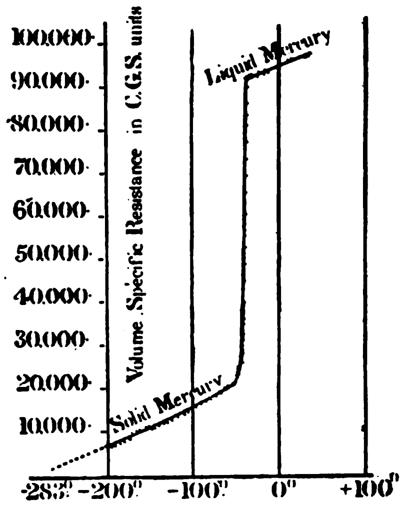


Fig. 7.

about 16 deg. C. Hence at ordinary temperatures small changes of temperature make no change in its resistance, but above this point its temperature coefficient is negative, and below it is positive. All alloys in which a negative temperature coefficient has been observed are probably instances of the same mode of variation of resistance. It may be noted, in passing, that the element manganese when present in an alloy seems to have a great tendency to produce high resistivity and small temperature coefficiency. Returning, then, to the pure metals, we may ask, What is the meaning of the fact that in their case the resistance lines all converge so as to indicate that the electrical resistance would vanish at the absolute zero of temperature? We know that the passage, as we call it, of an electric current through a conductor heats it, and that by Joule's law the rate of production of heat in the conductor is proportional to the square of the current strength and to the total resistance of the conductor. Suppose we take two wires, say, of iron and a certain copper-nickel-aluminum alloy, of the same size and length. These wires will at + 100 deg. C. have the same resistance. A unit current flowing through them will, therefore, generate heat in them both at the same rate. Cool them both down, however, to the temperature of liquid air. In the case of iron the resistance is reduced to one-fifteenth of its value at .200 deg. C.; in the other case it is reduced by only 10 per cent. Hence, at the low temperature the alloy dissipates energy for the same current nearly 13½ times as rapidly as the nickel.

It is a logical deduction from all we know to conclude that if we could reach the absolute zero of temperature, the pure metal would not dissipate the energy of the current at all. Imagine two iron wires, then, stretched through space, say, from the earth to the moon, and kept everywhere at the absolute zero of temperature. We could transmit any amount of electrical energy along them without dissipating any of it as heat in the wires. As a consequence of this, any pure metal cooled to the absolute zero of temperature would become a perfect screen for electro-magnetic radiation, and would be perfectly impenetrable to electro-magnetic induction. We can show this increase in the power of electromagnetic screening by metals when cooled in the following way: A suitable coil of wire is placed between the poles of an alternating current magnet and a small incandescent lamp connected with the coil. When the magnet is excited it induces currents in the coil, and the lamp glows up. A cap of aluminum is made of such a size as to drop easily over the coil. This aluminum is not of sufficient thickness or conductivity to screen off the induction when it is warm. If, however, we cool the aluminum cap in liquid air and then drop it over the coil, the lamp for one instant goes out, but it comes in again as the metal cap instantly warms up. This shows us, however, that if the cap were at the absolute zero of temperature it would be a complete screen for the induction. In fact, these experiments furnish us with a new definition of what we mean by the absolute zero of temperature. It is the temperature at which perfectly pure metals cease to have any electrical resistance.

In the conduction of currents at ordinary temperatures, as we generally know it, two effects are inseparably connected with the conveyance of energy by this process. One is the dissipation of some of the energy as heat in the conductor, the other is loss of potential or fall of electric pressure, and which is one of the factors in the equivalent of the energy so dissipated. If, however, the conductor is at the absolute zero of temperature, there is no dissipation of energy in it, and neither of these consequences would be present. There would be no heat produced in the conductor and no fall of potential along it either for large or small currents. What, then, under these conditions is the function of the conductor? The answer is that it becomes a mere boundary, serving to limit the electro-magnetic field and determine the direction in which the energy transmission is taking place. These experiments, therefore, may be regarded as forging one more important link in that chain of evidence which compels us to look for the processes concerned in the conveyance of energy by an electric current, not inside the conductor, as we call it, but in the dielectric, or medium outside. We may, then, ask how is it that different bodies have such various dissipative powers when acting in this way as the boundary of an electro-magnetic field? The only suggestion on this point I venture to make here is as follows: Materials of high specific resistance have all probably a very complex molecular structure. The alloys of high resistivity are not probably merely solidified mechanical mixtures of metals, but chemical compounds; and even in the case of elementary bodies like carbon and sulphur they may have, owing to their high valency and tendency of their atoms to auto-combination, a complex molecular structure. This structure may bestow upon them the power of taking up energy from the electro-magnetic medium, just as gases with a highly complex molecular structure are very absorbent of radiant heat, which, if the electro-magnetic theory of light is true, is only another form of electro-magnetic energy. All we know at present about the processes at work during the time a conductor is traversed by an electric current is that there is a magnetic field outside the conductor and also within the mass of the conductor, and that some mechanism is at work absorbing energy through the surface of the conductor and dissipating this as heat in the interior. The resistance of a conductor is best defined as the number expressing the rate at which it dissipates electro-magnetic energy per unit of current. For the same current—that is, for the same external magnetic field—conductors dissipate this energy at very different rates. Some, like silver and copper, which have the lowest rates, are elements of low valency and molecular volume, and have probably a simple molecular structure. Others, like alloys of high resistivity, have in all probability a more complex molecular structure. Both this last, as well as the molecular mobility characteristic of the liquid state, are conditions which bestow the power of taking up rapidly and dissipating the energy of the electro-magnetic field, and this has to be kept supplied from energy-transforming sources. We cannot, however, at present construct profitably further mechanical hypotheses to account for this difference in the presence of our great ignorance about ether, molecules, and energy.

In passing from the liquid to the solid state there is generally an immense increase in the conducting power of metals. This is well shown in the case of mercury. A glass tube a metre in length was formed into a spiral coil and filled with pure mercury, suitable connections being provided at the ends. This coil was embedded in a mass of paraffin wax, and a platinum-wire thermometer placed in contact with it. The whole mass was then reduced to the temperature of liquid air, and observations taken of the resistance of the mercury as it heated slowly up after being removed from the liquid air. The curve in Fig. 7 shows the manner in which the resistance increases with great suddenness between —41 deg. and —36 deg. as the metal passes into the liquid condition. The resistance becomes four times greater between —50 deg. and —36 deg. in the course of 14 degs. rise of temperature, and while in the act of pasisng through the melting point of the mercury at —38.8 deg. C. This chart shows that the resistance of the mercury in the solid state tends downward, so as to indicate that its resistivity would completely vanish exactly at the absolute zero of temperature. It is interesting to note also that the portion of the resistance curve belonging to mercury in the solid state is sensibly parallel to that portion of it in the liquid state.

MR. GEO. H. ALMON has been granted a franchise by the city of Barre, Vt., to establish a telephone exchange there. The city has 10,000 inhabitants and is five miles from Montpelier. He also has a franchise for the same purpose from the town of Waterbury and hopes to get one from Montpelier also.

THE JACQUES CARBON BATTERY.

BY C. J. REED.

IN The Electrical Engineer of April 13, 1896, a description is given of the Jacques "Carbon Consuming Primary Battery" so called. From the description and data given, it seemed evident to the writer that the electrical energy derived from this cell, instead of being evolved directly from the carbon, was produced by a thermo-electric junction. To determine this question three experiments were performed, the results of which indicate clearly that the action is thermo-electric.

The apparatus used in the first experiment is shown in Fig. 1. It consisted of a sheet-iron cup, L, having a long iron handle, to which a wire, W, was soldered. The free end of the wire was connected to one terminal of a Weston voltmeter, V. The cup was half filled with pure caustic soda and heated by the flame of a Bunsen burner, B. The other terminal

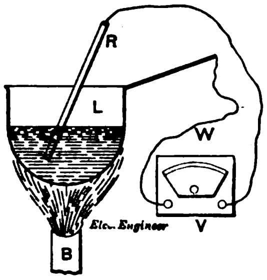


FIG. 1.

of the voltmeter was connected by a flexible wire to a conducting rod, R, the end of which was at frequent intervals inserted into the fused soda.

Rods of carbon, nickel, copper, iron, German-silver, lead, and cadmium were used. The reading of the voltmeter was taken as quickly as possible after bringing the rod in contact with the alkali. The rod was withdrawn after each reading and allowed to cool.

Readings were taken in this manner at intervals of one minute from the time the alkali fused until it attained the highest temperature and afterward until it cooled to the point of solidification. The results are shown in Fig. 2, in which the ordinates represent electromotive force, the unit being 0.01 volt, and the abscissæ represents time in minutes from the beginning of the experiment. The temperature gradually increased from 66° C., at which the alkali melted, to

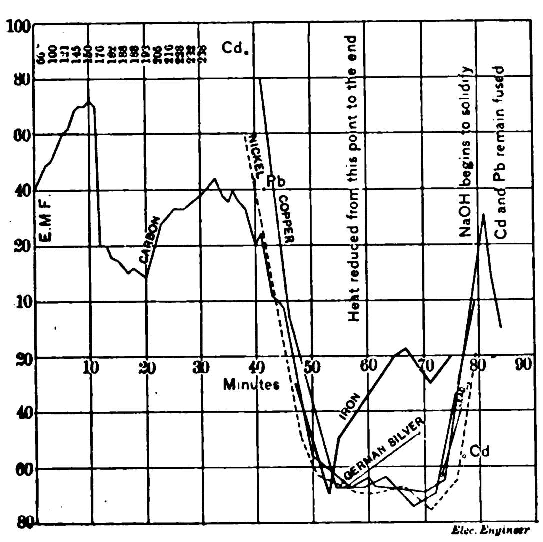


FIG. 2.

nearly a red heat. It was then gradually reduced by turning down the flame and finally removing it.

It is well known that sodic, as well as potassic, hydrate contains considerable water, which, after fusion, is gradually evaporated as the temperature increases, until, at a red heat, the water is nearly, though not quite, all expelled. A mercurial thermometer was used at the beginning of the experiment, the last reading being taken at 238° C., as shown in Fig. 2 at the end of 18 minutes.

In this experiment readings were not taken with the metal rods during the first 38 minutes, the original intention being to use only the carbon rod. The general coincidence, or at least, similarity, of the carbon curve with the metal curves, so far as they were taken, indicates clearly that there is no essential difference between them, and that the seat of electromotive force is the same, whether the rod be of carbon or of metal. The maximum electromotive force obtained from some of the metals is noticeably greater than that obtained at any point from the carbon.

Only two observations with the cadmium rod and three with

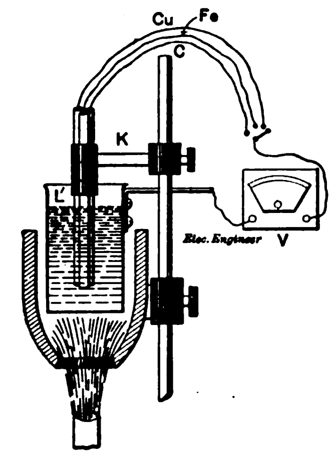


FIG. 3.

the lead rod were made, in all of which the metal melted almost immediately on touching the alkali. The first reading of the cadmium, taken at the thirty-ninth minute, showed it to be positive to the cup and the electromotive force to be 0.9 volt. The second reading at the seventy-seventh minute showed it to be negative to the cup and the electromotive force to be 0.58 volt.

The first reading of the lead rod at the forty-second minute showed the lead positive and the electromotive force 0.4 volt. The second and third readings at the seventy-third and seventy-eighth minutes showed the lead to be negative and the electromotive force to be 0.64 and 0.30.

The reversal of polarity or change from positive to negative at a temperature a little below a red heat is particularly in-

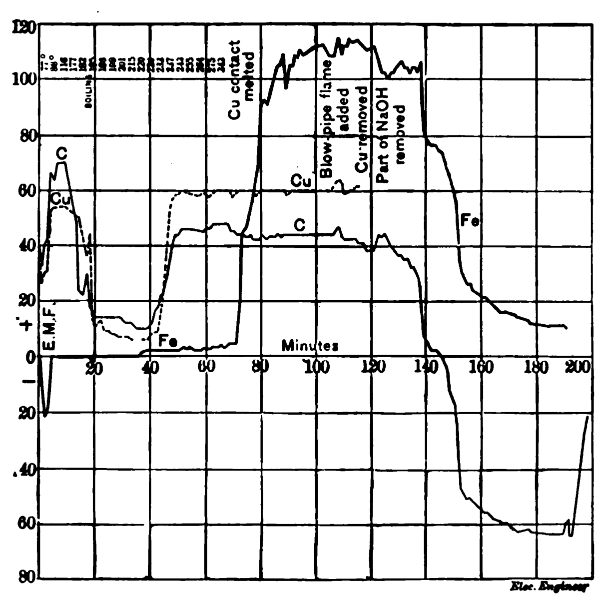


FIG. 4.

teresting and is, the writer believes, a sufficient proof that the action of the cell is thermo-electric and not galvanic. It is in accordance with the thermo-electric behavior of all substances, but cannot be reconciled to any rational theory of galvanic or chemical action. It cannot be possible, therefore, that the energy of the current in the case of carbon is derived from the consumption of the carbon rod. A careful examination of the carbon (arc-light carbon) rod before and after the experiment and also after prolonged use in other

experiments showed not the slightest indication of any change such as combustion would produce. The finest lines on its surface, formed in the process of manufacture, were unaltered by the experiments, and that part of the rod which had been immersed in the alkali could not be distinguished by its appearance from that which had not been immersed.

The curve for the iron rod indicates that the rod and cup, both being of iron, do not constitute the elements of the thermo-electric junction. A reasonable theory would be that the junction between the heated cup and the alkali is the

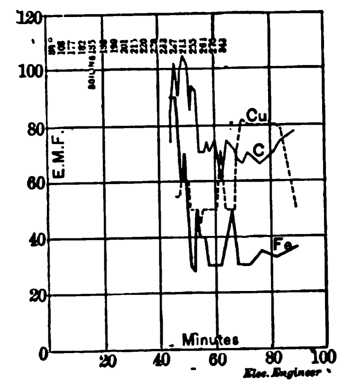


FIG. 5.

thermo-electric junction and that the rod acts merely as a conductor to connect the alkali with the external part of the circuit. On this theory we should expect what we find by this experiment to be the case, namely, that the substitution of rods of various metals for the carbon rod makes no essential difference in the result.

It will be noticed in Fig. 2 that after about forty-five minutes the polarity of all the rods reversed from positive to negative, and that the rate of change of electromotive force at that point was very rapid. After fifty-eight minutes the flame was turned down and the temperature gradually reduced. As the temperature fell the electromotive force also fell, and after seventy-eight minutes the carbon again reversed, becoming positive. It reacned a positive maximum of 0.31 volt and again reversed, being —0.10 when the alkali became entirely solid. The cadmium and lead that had melted off the rods and dropped into the cup still remained fused when the experiment came to an end after eighty-four minutes.

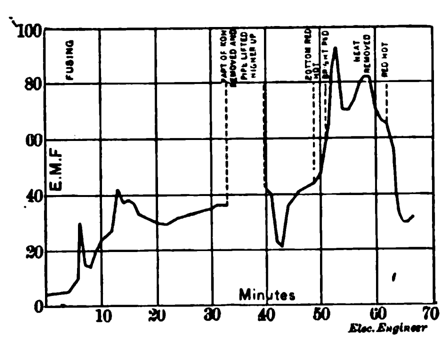


FIG. 6.

During the course of this experiment it was noticed that on dipping the conducting rod into the alkali with the voltmeter connections closed, the deflection of the needle, instead of remaining constant, changed rapidly and irregularly as the end of the rod became hot. The highest reading obtainable was the one recorded and used in constructing the curves of Fig. 2.

In order to compare more accurately the results obtained from rods of different materials and to make the comparison under conditions as nearly uniform as possible, a second experiment was performed with the apparatus shown in Fig. 3. The cup, L, was of sheet-iron, cylindrical in form, 2 inches in diameter and 2½ inches deep. It was filled to a depth of 2 inches with impure caustic potash. The cup was partly inclosed in a plumbago crucible of larger diameter, the bottom of which was removed. The handle of the cup was connected, as in the previous experiment, with one terminal of the voltmeter.

Three rods, one of carbon, one of copper and one of iron, each 12 inches long and ¼ inch in diameter were insulated by sheet asbestos and held close together in a vertical position by a suitable clamp, the lower ends of the rods dipping into the fused alkali. Each rod was connected by a separate wire to one contact piece of a three-point switch connected to the voltmeter, as shown in Fig. 3, in such a manner that connection through the voltmeter could be rapidly changed from one rod to another.

The alkali was first fused in the cup and allowed to cool. The rods were then brought in contact with the solid mass and the flame of the Bunsen burner was applied. The copper and carbon rods indicated a positive electromotive force immediately, which increased until the alkali fusea, when it reached 0.40 volt and the temperature of the mass was 77° C.

From that point a reading was taken every minute from each of the three rods, the contacts being made in rapid succession, first with the carbon, next with the copper, and then with the iron. At the end of forty-eight minutes the water was nearly all expelled and the fused mass became quiet. At the same time the temperature began to rise rapidly. The last reading of the thermometer taken at thirty-eight minutes was 343° C. After seventy minutes the solder joining the top of the copper rod to the conducting wire melted and contact was afterward made by hand.

At 104 minutes the blowpipe flame was substituted for the Bunsen burner; but it was found that the temperature could not be further increased on account of the rapidity with which the heat was conducted away by the copper rod. The copper rod and a part of the alkali were, therefore, removed a few minutes later. The temperature then rapidly rose to a bright red heat, while the electromotive force of both the carbon and the iron fell, the carbon reversing and attaining a negative maximum of 0.65 volt. The results are graphically shown in Fig. 4.

The curves show that the highest electromotive force was produced by the iron rod and that at a certain temperature a little below a read heat it gave 1.15 volt.

This remarkable electromotive force can be due only to the difference in temperature between the two junctions of the alkali and iron the lower and hotter junction being that of the alkali and iron cup, the upper and colder junction being that of the alkali and iron rod. The difference of temperature between these two junctions could not under the circumstances have been very great, probably not over 100° C., and possibly very much less. Hence, the thermo-electric power of this junction between iron and alkali must be enormous, compared with that of thermo-electric couples composed of any two metals.

During the interval between the forty-fourth and the eighty-ninth minute observations were also made by momentarily dipping into the alkali cold rods of copper, iron and carbon. These readings, when compared with the simultaneous readings of the hot rods, show that the electromotive force is greater with the cold than with the hot rods. Curves from the readings of the cold rods are shown in Fig. 5.

The average of all readings for each of the hot and for each of the cold rods taken during this period is given in tabular form below.

	Hot.	Cold.
Carbon.	.41	.80
Iron.	.14	.42
Copper.	.57	.58

While these figures should be relied upon only as a qualitative guide, they are sufficient to show that the greater electromotive force is obtained with the cold rods; or that the electromotive force is increased by increasing the difference in temperature between the upper and lower junctions.

The blast of air used by Dr. Jacques undoubtedly contributed towards increasing this difference in the temperature, and, hence, the electromotive force of his battery. The writer found also that a jet of illuminating gas has the same effect. This would seem to dispose of the theory that the electromotive force is a result of an oxidizing effect of the injected air upon the carbon rod.

In the third experiment the apparatus shown in Fig. 3 was used, the rods being replaced by a long piece of iron gas-pipe which was bent into a narrow U, the bottom of the U dipping into the alkali. A blast of cold air was continually blown through the pipe and pure caustic soda was used. The results are shown in Fig. 6.

At the end of half an hour it was found that a red heat could not be obtained, even by using the blast-lamp, on account of the cooling effect of the air passing through the iron pipe. The electromotive force reached only 0.40 volt. A por-

tion of the sodic hydrate was, therefore, removed and the gas-pipe was raised up until it barely touched the fused caustic. The temperature then rapidly increased to a bright red heat and the electromotive force rose to 0.94 volt, the highest that could be obtained. In this experiment, as in the previous one, the iron pipe remained positive to the cup; while in the first experiment the iron rod became negative at a high temperature.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Biographical:

PROF. STOLETOW.—Obituary with a list of his chief electrical papers.—London "Electrician," July 3, 1896. "Electrical Engineer," July 22, 1896.

WILLIAM SELLERS.—Biographical sketch with portrait.—"Cassier's Magazine," July 1, 1896.

Central Stations:

SOME CENTRAL STATION ECONOMIES.—By P. G. Gossler. Paper read before the Canadian Elec. Ass'n. The paper deals principally with results obtained from the partial reconstruction of a large plant.—"Electrical Engineer," July 8, 1896.

MUNICIPAL OWNERSHIP OF ELECTRIC AND GAS PLANTS.—By Allen R. Foote. Paper read before the Convention of Street Lighting Officials, New Haven, Conn., June 18, 1896. Arguments against municipal ownership. "Elec. World," July 11, 1896. "Electrical Engineer," July 15, 1896, et seq.

THE CENTRAL STATION IN GRAZ.—By Josef Pojatzi. Details of plant, describing the generating plant, distribution network, street lighting. "Zeitschr. f. Elektrotechn," July 1, 1896.

ELECTRICAL INSTALLATION AT ODESSA.—By Alexander Branner. Short description of installation. The plant was built by the city, run at a loss, was then leased to a private company and will go back to the city after 15 years. "Zeitschr. f. Elektrotechn," July 1, 1896.

Dynamos and Motors:

PHENOMENA OF COMMUTATOR RESISTANCE.—By H. J. Edsall and M. C. Rorty. Abstract of a thesis, Cornell Univ. Description of method, with summary of results obtained. "Electrical Engineer," July 8, 1896.

STUDY OF A THREE-PHASE MOTOR.—By C. W. van Law and H. S. Simpson. Abstract of a thesis, Cornell Univ. "Electrical Engineer," July 8, 1896.

THE DIRECT-COUPLED GENERATOR AT STOCKWELL POWER STATION.—Detailed description with elevation, partly in section, of the Willans-Siemens direct-coupled railway generator plant at the Stockwell station of the City and South London Railway.—London "Electrician," July 3, 1896.

POWER FACTOR.—An explanation of its significance in actual practice.—London "Elect. Review," July 3, 1896.

Educational:

SCIENCE AND ENGINEERING.—By Thomas Curtis CLARKE, President Am. Soc. C. E. Author shows the necessary relations between science and engineering. "Railroad Gazette," July 10, 1896.

Electro-Chemistry:

DIRECT PRODUCTION OF ELECTRICITY FROM COAL.—By G. H. Stockbridge. Author reviews Dr. Jacques' method, mentions the work done by his predecessors in this field of research, but mentions that the efficiency noted for the Jacques apparatus is the efficiency of the generating cell, irrespective of the expenditure of heat for maintaining the cell at a suitable temperature, and of power in running the air pump which supplies it with oxygen.—"Engineering Magazine," July, 1896.

TRANSFORMATION OF THE ENERGY OF CARBON INTO OTHER AVAILABLE FORMS.—By C. J. Reed. Paper read before the Franklin Institute, May 26, 1896. A review of all principal methods, known at the present time for converting the energy contained in carbon into the numerous forms of energy that are directly available to man.—"Electrical World," July 11, 1896, "Journal of Franklin Institute," July, 1896, "Electrical Engineer," July 15, 1896.

Electro Physics:

ADMITTANCE AND IMPEDANCE.—By F. Bedell, Ph. D. Paper read at the meeting of the Physical Society, June 26, 1896. Author discussed the application of the mehtod of vector diagrams to the solution of questions connected with alternating currents. He shows how, by a consideration of the loci of the different lines on such a diagram, many problems may be solved simply.—London "Engineering," July 3, 1896.

PROPERTIES OF A BODY HAVING A NEGATIVE RESISTANCE.—By S. P. Thompson. Paper read before the Physical Society, June 26, 1896. Author discusses observations made by Frith and Rodgers in a paper read at a previous meeting. A number of prominent engineers took part in the discussion.—London "Engineering," July 3, 1896.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES.—By J. A. Fleming, M. A., F. R. S. A discourse delivered at the Royal Institution, June 5, 1896. Results of investigations made conjointly with Prof. Dewar during the last four years.—"Electrical Engineer," July 8, 1896, et seq.

Lighting:

INTERVIEW WITH MR. C. P. FELDMANN, OF COLOGNE, ON ELECTRIC LIGHT MAINS.—Some opinions on underground mains.—London "Electrical Engineer," July 3, 1896, et seq.

A PRACTICAL EXPOSITION OF ELECTRIC LIGHTING.—By W. A. Anthony. A discussion of Prof. F. B. Crocker's recent book on Electric Lighting.—"Engineering Magazine," July, 1896.

ON THE CAUSE OF CONTINUOUS SPECTRA IN EXHAUSTED TUBES.—By Dr. W. H. Birchmore. Writer has among his collection of vacuum tubes a particular one which presents remarkable phenomena when subjected to the action of an electric current. These are light phenomena and are described in detail in "Electrical Engineer," July 8, 1896.

SOME FAULTS IN ARC LAMP CARBONS.—By W. M. Stine. Author mentions some troubles found in carbons, but finds that unsatisfactory working often lies in the lamp. Iron and silicon should never be in the carbons.—"Electrical World," July 11, 1896.

ELECTRIC LIGHTING ON THE STEAMER ADIRONDACK.—A compound wound 50 kilowatt generator is directly coupled to the engine. Two large and one small units are installed. Total capacity is 1,750 lights and 1,300 are in constant use.—"Electrical World," July 11, 1896.

ELECTRIC STREET LIGHTING.—By M. J. Francisco. Abstract of a paper read June 19, 1896, before the Convention of Street Lighting Officials, New Haven, Conn. A discussion on municipal ownership, giving results observed in different places.—"Electrical World," July 11, 1896.

ARC LIGHTING FROM ALTERNATING CURRENT LIGHTING STATIONS.—By Frank Lewis. Author points out the advantages of this method, such as the independence of each lamp, and compares the alternating with continuous current arc.—London "Electric Review," July 3, 1896.

Magnetism:

IRON-ANTIMONY ALLOYS.—By Pierre Weiss. Communicated to Soc. Franc. de Phys. These alloys hold a position between the large class of feebly paramagnetic bodies and the group of iron and nickel combinations having strong magnetic properties. Hysteresis diagrams were made with a view of comparison with the Steinmetz formula and found to agree well in some cases, but for an alloy of 53 per cent. of iron the exponent was about 2.17, this figure falling gradually to the standard as the proportion of iron increased. Short Abstract in London "Electrical Engineer," July 3, 1896.

Measurements:

CALIBRATION OF SLIDE WIRE BRIDGD.—By A. C. Benecke. Description of a simple method.—"Electricity," July 8, 1896.

RESISTANCE OF THE ARC.—By Prof. W. E. Ayrton. A letter in connection with Prof. Thompson's paper on negative resistance. The writer disagrees with Prof. Thompson and quotes communications by Mrs. Ayrton on the subject. Prof. Thompson's answer follows the letter.—London "Electrician," July 3, 1896.

Mechanical:

ELECTRIC FIRE ENGINE.—By Chas. Brezol. This consists essentially of a force pump of the usual type, driven by a two-pole motor, geared down to give the necessary speed re-

duction. An illustrated description appeared in "L'Energie Electrique," and reference to it is made in the London "Electrical Engineer," July 3, 1896.

Railways:

STATION FITTINGS.—By Philip Dawson. In the series on "Electric Traction." Author has arrived at the discussion of switchboards, describing the instruments to be placed thereon, the requirements for a testing room, and closes with a discussion on the protection of telephone and telegraph wires.—London "Engineering," July 3, 1896.

RAILWAY BLOCK SIGNALLING.—By J. Pigg. Writer traces the Block system from its beginning and discusses signals for ordinary working, for emergencies, and for special purposes.—London "Electrical Engineer," July 3, 1896, et seq.

ELECTRIC TRACTION.—By R. St. George Moore. A review of its application and a comparison with other methods. —London "Electrical Engineer," July 3, 1896.

BRIDGES FOR ELECTRIC RAILROADS.—By Chas. F. Stowell, C. E. A warning to railroad companies, and some figures to show the amount of weight a bridge has to stand if it is used to carry motor cars.—"Railroad Gazette," July 10, 1896.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 14, 1896.

Alarms and Signals:—

ANNUNCIATOR SYSTEM FOR BUILDINGS. J. M. Arthur, Detroit, Mich., 563,724. Filed April 1, 1896.
Means for indicating at a central station such as an annunciator whether each door in the building is locked or unlocked.

AUTOMATIC FIRE ALARM SYSTEM. J. Young, Chicago, Ill., 563,832. Filed Aug. 8, 1895.
Two circuits extending throughout the district to be protected, signal devices in each circuit, and means for intercepting a signal when but one of said signal transmitting devices is operated.

RAILWAY SIGNAL. C. Hansel, Easton, Pa., 563,924. Filed Dec. 4, 1895.
Means for indicating at the signal station the position of the semaphore.

SPEED AND DIRECTION INDICATOR. G. A. Tower, Richmond, Va., 564,168. Filed March 21, 1896.
Adapted for use on shipboard to positively indicate in the pilot house the direction in which the propeller is turning.

Conductors, Conduits, and Insulators:—

ARMORED INSULATING CONDUIT. R. T. Elwell, Hyde Park, Mass., 564,174. Filed Jan. 28, 1896.
Consists of a metallic armor tube, and an inclosed insulating tube of pliable rubber having sufficient hardness to retain its tubular form and resist fracture when bent.

Dynamos and Motors:—

ROTARY TRANSFORMER. E. Thomson, Swampscott, Mass., 563,895. Filed Dec. 21, 1893.
Means for self-regulation.

DYNAMO ELECTRIC MACHINE. W. Cooper, Schenectady, N. Y., 563,911. Filed April 18, 1896.
A field magnet structure provided with laminated pole-pieces, certain of the laminæ being of less extent than others.

DYNAMO ELECTRIC MACHINE. A. L. Parcelle, Boston, Mass., 563,940. Filed Jan. 7, 1896.
The combination, with an alternating current generator, of a synchronous rotary transformer, and a two-part commutator, which is connected to the secondary of the said transformer.

Electro-Metallurgy:—

COATING METALS BY ELECTROLYSIS. H. Alexander, Berlin, Germany, 563,723. Filed July 31, 1895.
Composed of a solution of from five to eight parts of commercial chloride of aluminum, containing free acid in 100 parts of water, and of so much of reguline coating metal as will dissolve therein, while the bath is heated to the boiling point, and from two-tenths to three-tenths of a part of chloride of the coating metal.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. J. C. Knight, Roselle, N. J., 563,773. Filed Nov. 21, 1895.
Shunt-controlled feed mechanism.

ELECTRIC LAMP STAND. W. D. Gridley, Brooklyn, N. Y., 563,922. Filed Feb. 19, 1896.
Details of construction.

ELECTRIC LIGHT FOR COLD STORAGE ROOMS. D. B. and R. H. Hawes, Springfield, Mass., 563,960. Filed May 22, 1896.
Lamp is lighted by opening door of room and extinguished by closing same.

ELECTRIC HEADLIGHT FOR STREET CARS. A. C. Thompson, St. Louis, Mo., 564,036. Filed Aug. 26, 1895.
Details of construction.

Measurement:—

INSTRUMENT FOR MEASUREMENT OF ELECTRIC RESISTANCES. S. Evershed, London, England, 563,917. Filed Feb. 6, 1896.
Consists of a cross-shaped magnetic needle system of soft iron, the lower vertical limb of which is adapted as a tube to receive an internal supporting pin, in combination with surrounding exciting coils, to form an astatic needle.

Miscellaneous:—

ELECTRIC HEATER. C. H. Minchew, Taunton, Mass., 563,780. Filed Nov. 19, 1895.
Embodies a series of parallel longitudinal heating coils embedded in non-conducting packing.

THERMOSTAT. L. G. Woolley, Grand Rapids, Mich., 563,831. Filed June 24, 1895.
Means for mechanically removing any corrosion from the point of contact of the electrodes.

METHOD OF AND APPARATUS FOR REGULATING TEMPERATURE OF ELECTROLYTES. R. Kroseberg and E. Straub, Berlin, Germany, 563,912. Filed July 13, 1893.
Consists in passing a continuous current of a regulating fluid in contact with a series of hollow electrodes connected with the opposite poles of the source of electricity, each electrode thus forming both anode and cathode.

PROTECTIVE APPLIANCE FOR ELECTRICAL APPARATUS. A. De Khotinsky, Boston, Mass., 564084. Filed May 5, 1896.
Consists of a rod of carbon forming a part of the circuit and held by a spring in tensile or longitudinal strain and means whereby the circuit is opened and grounded when the rod is volatilized.

PROCESS OF AND APPARATUS FOR AGING BEER, WINE, ETC. F. C. Wiedring, Chicago, Ill., 563,130. Filed June 11, 1894.
Employs a mass of small pieces of metal arranged in the bottom of the receptacle and in contact with each other, so as to form a closed electrical circuit, and a source of electricity electrically connected with said mass of metal.

HYDROCARBON BURNER. E. G. Mummery, Detroit, Mich., 563,398. Filed Jan. 25, 1896. Issued June 30, 1896.
Details of construction.

ELECTRICAL PROGRAM-CLOCK. Andrew J. Reams, Chicago, Ill., 563,883. Filed Nov. 20, 1895.
Details of construction.

ELECTRIC-GENERATOR ATTACHMENT FOR DENTAL ENGINES. Claude L. Woolley, Baltimore, Md., 563,995. Filed May 18, 1896.
The combination of the drive-pulley of a dental engine, the standard of said engine, and electric generator supported by said standard and having a revoluble armature, which is driven by contact with said drive-pulley.

Railways and Appliances:—

TROLLEY WHEEL. W. C. Cottrell, Asbury Park, N. J., 563,749. Filed Aug. 28, 1895.
Consists of a larger and a smaller wheel with ball bearings between the two.

TROLLEY FINDER. H. H. Blanchard, Augusta, Me., 563,998. Filed Sept. 24, 1894.
Flaring arms are fastened to the shaft on which the wheel revolves and are brought into an upright position by a suitable cord or pulley down the trolley below the wire.

ELECTRIC RAILWAY SYSTEM. D. M. De Witt, Morrillton, and W. K. Elliott, Little Rock, Ark., 564,054. Filed Jan. 29, 1896.
Conductors are laid in conduits along the track, normally insulated therefrom, and contact is made through devices operated by moving cars.

POWER GEARING FOR ELECTRIC CARS. E. A. Sperry, Cleveland, O., 563,425. Filed June 9, 1894. Issued June 30, 1896.
Comprises a motor, the running gear of the car, power-driving connection from the motor to the running gear, and inclosing housing for the connection, consisting of two independent casings, one only mounted upon the axle, and the other mounted upon the motor supporting bar.

BRAKE FOR ELECTRIC CARS. Walter V. Ash, Irvington, N. J., 563,725. Filed Aug. 5, 1895.
The combination with the car and brake operating means, of a connecting-rod and two shoe-sections, one to engage the track and other the wheel, said sections being pivoted to one another and to said connecting rod.

AERO-ELECTRIC AUTOMATIC BRAKE. Charles Luyers, Brussels, Belgium, 563,934. Filed Sept. 29, 1894.
Employs electric relief-valves.

Regulation:

SPEED REGULATOR FOR DYNAMOS. C. E. Scribner, Chicago, Ill., 563,317. Filed Dec. 10, 1888. Issued June 30, 1896.
Embodies a driving shaft for rotating the armature, a variable speed connection between said driving shaft and said armature and means operated by the variation of the pull upon the armature for automatically changing the speed with which said variable speed connection drives the armature.

Switches, Cut-Outs etc.:—

CIRCUIT-CONTROLLING DEVICE. J. H. Clark, Boston, Mass., 563,743. Filed Jan. 29, 1892.
Provides a single set of resistance contacts so connecting the regulating member thereof with the operating shaft that the said regulating member will be moved in the same direction over a single set of resistance contacts by movement of the operating shaft in opposite directions.

Telegraphs:—

PRINTING TELEGRAPHY. J. J. Reifgraber, St. Louis, Mo., 564,101. Filed July 30, 1895.
Details of system.

Telephones:—

TELEPHONE SYSTEM. W. R. Patterson, Chicago, Ill., 563,877. Filed Jan. 21, 1896.
In a substation telephone system means for sounding a signal when the subscriber hangs up his receiver and has neglected to return his plug to his individual spring jack.

TELEPHONE SYSTEM. A. Graham, London, England, 563,920. Filed May 3, 1894.
Obviates the use of call bells.

TELEPHONE TRANSMITTER. H. A. Martin, Hartford, Conn., 563,935. Filed Nov. 13, 1895.
Comprises a chambered body, a diaphragm, a movable member in the chamber of said body, and two non-mixable conducting fluids in said chamber, one of said fluids being supported by and resting on the other fluid.

TELEPHONE EXCHANGE APPARATUS. J. J. Carty, New York, 564,173. Filed Nov. 17, 1887.
Details of construction.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

MAGNETIC BLOW OUT CUT-OUT BOX.

The magnetic blow out principle with which we are familiar in the street car controllers, automatic circuit breakers and lightning arresters has been recently applied to the smaller currents. In the form "H" cut-out box, shown in the accompanying engravings, the General Electric Company has provided a cheap and simple means for the protection of direct current generators and other apparatus against the destructive effects of overload and short circuits, provided the current does not exceed 600 volts and 100 amperes. It may be fitted with fuses of any capacity from three amperes to 100 amperes, and any arc which may occur is instantly extinguished. Under test this cut-out box even handled a short circuit of 2,000 amperes at 500 volts, extinguishing the arc instantaneously.

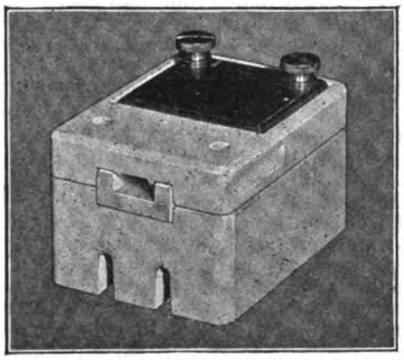


Fig. 1.—The G. E. Magnetic Blow-Out Cut-Out.

The box is of porcelain 5¾ inches by 4¼ inches by 4 inches thick. The fuse is secured in the cover and when the cover is in position rests in a closed chute. The base of the box contains a small electromagnet in circuit with the fuse having its magnetic circuit continued by the iron plate on the cover and by the iron screw posts. The magnetic lines are thus compelled to pass across the space containing the fuse, maintaining a strong magnetic field in the chute when the current is flowing. At the blowing of the fuse the arc which starts finds itself in a powerful field and is immediately extinguished.

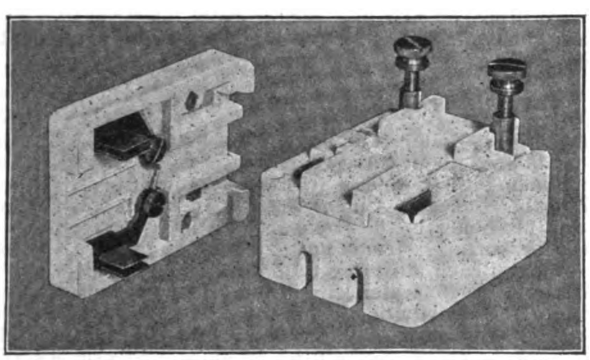


Fig. 2.—The G. E. Magnetic Blow-Out Cut-Out.

ELECTRIC VEHICLES AT CHICAGO.

ELECTRICALLY propelled carriages are being sold and rented by the American Electric Vehicle Company, of 447 Wabash avenue, Chicago. They are turning out handsomely finished vehicles, furnished with storage batteries and motors and especially devised braking and steering gears. Henry Potwin is president, F. S. Culver vice-president, C. E. Corrigan general manager and treasurer, and C. E. Woods secretary. They have completed for use an electric mail phaeton which has an equipment of two 2 horse-power motors at a normal working rate which can be momentarily run up to 6 or 7 horse-power. The motors are connected, one on either hind wheel, independently, and are run in series or parallel, giving variations of speed. The special feature of these motors is that they are dust and water proof, and are especially designed for this class of work. The battery equipment consists of thirty-two 180 ampere-hour cells, made by the Syracuse Storage Battery Company, which are grouped in series or parallel by a controller, and, working in conjunction with the motors, make possible five different speeds.

The vehicle is supplied with two brakes—one a band brake applied to the sheave on the shaft of the sprocket wheel, the other an emergency brake which operates directly on the tires. The arrangement of the mechanism in the latter brake is such that the act of putting it on not only cuts the current off from the motors, but automatically sets the controller back to the starting point. The maximum speed of the vehicle is 15 miles an hour. The batteries weigh 1000 pounds and will give a continuous 6 or 7 horse-power service.

THE CARBON ELECTRIC GENERATOR CO.

The Carbon Electric Generator Company, which has taken over Dr. Jacques' inventions for obtaining electricity directly from coal, has been organized, with a capital stock of $5,000,000. Mr. William H. Forbes, formerly president, and now a director and member of the executive committee of the American Bell Telephone Company, is president. The directors are Mr. Forbes, Mr. C. P. Bowditch (also a director and member of the executive committee of the American Bell Company), Messrs. F. G. Webster and Robert Winsor, of the banking house of Kidder, Peabody & Co.; Dr. W. W. Jacques, and Mr. Charles A. Stone. Mr. W. Cameron Forbes is treasurer. The executive offices are at 95 Milk street, Boston, and the engineering department, which is in charge of Dr. Jacques, is at 104 Milk street.

While the invention has been made and a broad patent for it granted, and while it is clear that the first cost of the generator is far less than that of equivalent steam boilers, engines and dynamos, and careful tests, show that the fuel consumption and attendance required are very small, there are still many details to be worked out before the generator can be put into commercial use in a large way. Extensive laboratories have been equipped and a corps of experts is now engaged in developing the invention so that it may meet the requirements of the various commercial purposes for which it is suitable to be used.

NEW FACTORY OF THE BEACON LAMP CO.

The Beacon Lamp Company, of Boston, are building, at New Brunswick, N. J., a new brick lamp factory, 200 x 100 feet, two and a half stories high. Their business has increased to such an extent that their present quarters are entirely too small. The reasons for moving to New Brunswick are the excellent shipping facilities which that place affords, and the company's increased export trade which is generally shipped from New York. They expect to be in their new building about September 1.

THE F. W. OLIVER CO.

The F. W. Oliver Co., of Niagara Falls, have just installed lighting plants in the plant of the Niagara Paper Company and also in the mill of the Traders' Paper Company, both of Lockport, N. Y.

The Oliver Company have received a contract for a 60 horse-power slow speed motor to be connected to the refrigerating apparatus of the Niagara Falls Brewing Company. This motor will be operated from the new generators of the Cliff Paper Company until such time as the new power plant of the Niagara Falls Hydraulic Power and Manufacturing Co. is in operation.

THE STANDARD UNDERGROUND CABLE COMPANY are determined to place themselves in a position where they can handle a contract for any character of installation with the least possible delay. For years they have been able to successfully undertake any contract for installing underground cables of high character, except conduits for rubber-covered wires and cables. Appreciating the importance of meeting every possible demand on the part of the electrical public, a large addition to their already extensive factories has been erected, and a complete modern plant for insulating wire and cables of all descriptions with rubber has been installed therein. This branch of their business has met with unexpected approval on the part of customers, and the high character of the product will undoubtedly steadily increase the output. The arrangements for testing the wires are particularly complete, and the care exercised in this department insures the production of absolutely perfect insulation, or the discovery of any faults before the wire leaves the factory.

NEW YORK NOTES.

WENDELL & MACDUFFIE, 26 Cortlandt street, New York, have just finished the installation of motors, wiring and lighting in V. Henry Rothschild & Co.'s shirt factory, at Trenton, N. J. This work consisted chiefly of the installing of a 60 kilowatt Thompson-Ryan dynamo, manufactured by the J. H. McEwen Manufacturing Company; eight E. G. Bernard Co.'s motors, wiring, etc.

THE NEW YORK ELECTRICAL COMPANY, 393 Pearl street, New York, are putting on the market a superior watch case receiver which they quote at 50 cents. It is very strong, made of the finest tool steel, and so highly magnetized that it will hold suspended its own weight. This company manufactures also medical batteries and other specialties in electrical supplies and will take pleasure in mailing catalogues to any address on application.

MR. CYRUS ROBINSON, who for years has occupied the position of manager and engineer of the Jeffrey Manufacturing Company, of Columbus, O., has resigned his position with that company, and has allied himself with the J. H. McEwen Manufacturing Company, in New York, as general manager of the sales department. Mr. Robinson is well known in the East, being well posted on electrical work, and will be welcomed by many electrical workers in this city.

THE GENERAL ELECTRIC COMPANY'S long burning arc lamp is meeting with considerable favor. Several extensive orders have been recently secured, 350 of both the 100 and 150 hour type having been shipped to Hartford, Conn., and nearly 200 to Warren, R. I. The company is also giving considerable attention to the question of mill lighting with these long burning arc lamps, and a large number have recently been purchased for the lighting of several large cotton mills in the South and elsewhere.

THE S. & B. ELECTRIC COMPANY, 72 and 74 Fulton street, New York, though a comparatively new firm in the electric line, are doing a very satisfactory business, owing to personal attention to all matters and prompt shipment of orders. This concern bought out the Mason Electric Exchange in 1895, which was run by Jas. H. Mason, the inventor and patentee of the well-known Mason battery. The S. & B. Electric Company are the sole manufacturers of these cells and also handle a great variety of electric supplies, novelties, etc.

THE "PIONEER" once more claims our attention by a quaint but striking illustration of the arc lamp trimmer on his ladder scattering dust from the old arc lamp. This is one thing which the "Pioneer" certainly spares its users, and it is quite a feather in the cap of the enclosed arc lamp that a pair of carbons will burn 150 hours without attention. This means time and money saved as well as great annoyance avoided.

We are advised that the original advertising of the Electric Arc Light Company has quickly brought the merits of the "Pioneer" to the eyes of electricians and lamp purchasers, and daily the show rooms at 687 and 689 Broadway are thronged with visitors. The genial manager, Mr. Joseph Bijur, assures a hearty welcome to all.

PATTERSON, GOTTFRIED & HUNTER, LTD., the largest general supply house for machinery, metals, hardware, tools, etc., in this country, are well located for their line of business at 146-150 Centre street, New York. This firm occupies four floors of about 23,000 square feet, which, withal, gives them hardly room to carry their enormous and varied stock, suitable for electric light plants, factories, machine shops, etc. Having a force of about seventy employés, they are well prepared and constantly busy filling the many orders, both large and small, for supplies of all kinds from all over the country. Messrs. Patterson, Gottfried & Hunter supply the largest electric plants, factories, etc., and it is safe to say that there is hardly a tool or supply in the market but what they have it in stock, ready to ship on order. This firm will mail price lists and catalogues on application.

WESTERN NOTES.

THE order for the two 40 kilowatt and one 20 kilowatt direct connected multipolar generators with panel switchboard for the Ohio State Hospital at Columbus, O., was awarded to the Triumph Electric Company, of Cincinnati, O., with Buffalo Forge Works engine. Alexander Schulmann, of the same place, secured the contract for wiring.

THE AMERICAN BATTERY COMPANY, 40 West Quincy street, Chicago, have received a handsome bronze medal and diploma, which was awarded to them by the World's Columbian Commission for excellence of design, efficiency, and indications of due ability in the storage batteries which they exhibited at the World's Fair, and was the only award given for exhibits of storage batteries made in this country.

THE ELECTRIC APPLIANCE COMPANY state that they are now in a position to quote specially low prices on Paranite cables of extra large carrying capacity up to a million circular mils. They are also able to make very prompt deliveries, as the nearness of the Indiana Company's factory precludes the possibility of delays in transit. Paranite telephone cables from ten to five hundred conductors are also in large demand, and the Electric Appliance Company have secured a number of good orders.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY have contracted to furnish telephone systems for Sandersville, Ga., Maysville, Ky., Cobbleskill, N. Y., Hot Sprngs, S. D., Cape May, N. J., Auburn, Ind., La Crosse, Wis., and have practically arranged for exchanges at Minneapolis and St. Paul. The La Crosse Telephone Company have purchased a 900-switchboard equipment from the Western Telephone Construction Company. The Keelyn system of central office equipment will be used.

THE CHAS. E. GREGORY COMPANY, South Jefferson street, Chicago, in getting out their July Bargain Sheet, hit upon a novel and effective departure from their regular style. The sheet itself was gotten up in the usual way with the exception of having four alternate heavy red and blue diagonal lines printed across the front cover, which was in itself a sufficient means of attracting notice to it. A short piece of twine being slipped over one end of an inside page with the ends of the twine projecting a little from the other end of the page, the whole being rolled up and slipped inside of a roll composed of Chinese red paper, left to all outward appearances so good an imitation of a fire cracker as to deceive the average small boy until he found out that he was wasting matches in his efforts to get it to go off.

NEW ENGLAND NOTES.

MR. F. WILLIAM ERICKSON, who has for the last twelve years been engaged in electrical construction work with the Edison Company and the Electrical Equipment Company, of New York and in Boston, representing General Electric and Edison interests, is now connected with the Lord Electric Company in Boston. This is only a young construction company, but they have already attained considerable prominence, and in the past year have installed upward of fifty thousand lights. They are prepared to equip entire steam, electric and power plants and have facilities for the engineering and equipment of electric roads.

THE HOGAN BOILER CO.

The Hogan Boiler Company, Middletown, N. Y.., are now established about three years and have been very successful in placing their boilers with many concerns in different parts of the country. Among the many features which have brought this boiler to the front are: No scale accumulates on the heating surfaces, drums not exposed to the heat collecting all sediments; each steaming tube discharges directly into the steam space; each water circulating tube discharges downward into the distributing drums, where precipitation of the impurities takes place. Water flows into the heating tubes as rapidly as steam is produced in them and escapes from them. Steaming tubes are over the fire and are exposed to the direct action of the heat of the fire and of the gases. The water circulating tubes are not exposed to the heat so as to secure downward currents. Steam can be raised in twenty minutes without injury to any part.

Contractor John B. McDonald in ordering a second new 300 horse-power Hogan boiler for the Jerome Park reservoir, New York, summarizes in brief regarding the first in use: "That the 240 horse-power water tube boiler installed by this company at Jerome Park reservoir for an air compressor outfit, is doing excellent work driving a compound condensing Corliss engine, steam cylinder, 24 x 44 x 48; air cylinders 24¼ x 48. The compressor runs, daily, ten rock drills, fifteen hoisting engines and three pumps, with capacity of at least 25 per cent additional service in drills and hoists." Among the many other places these boilers have been installed, constantly in use and never cleaned for scale, etc., may be mentioned the Middletown State Homœpathic Hospital, Middletown, N. Y.; National Starch Works, Glen Cove, L. I.; Franklin Illuminating Company, Sea Cliff, L. I.; Geo. Monroe Publishing Company, 17 Vandewater street, New York City, and many other representative concerns in different parts of the country. The Hogan Boiler Company is a pushing concern and with the many orders to fill, its prospects for the future are exceedingly bright.

Department News Items will be found in advertising pages.

THE

Electrical Engineer.

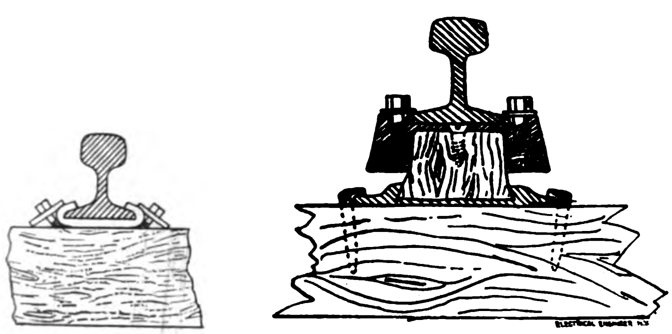
Vol. XXII. AUGUST 5, 1896. No. 431.

Electric Transportation.

THIRD RAIL CONDUCTORS.

BY LEO DAFT.

THE account in The Electrical Engineer of July 1, of the excellent performance of the cars on the Nantasket Beach electric road, recently equipped with a third rail, so vividly recalls the use of similar conducting devices in early electric railroad days, that I venture to relate a few experiences with



Figs. 1 and 2.—Daft Third-Rail Insulators.

third rails as conductors, in the hope that they may not prove entirely uninteresting at the present time.

In October, 1883, I equipped 1.25 miles of the main line of the Saratoga, Mount McGregor and Lake George steam railroad, for experimental purposes, with a 35-pound third rail, placed midway between the service rails of the track, and insulated by means of wood blocks which had been thoroughly baked and plunged into boiling pitch while hot from the baking. The foot of the rail was further protected by sheets of soft rubber curled back over the flange and held by square washers under the head of lags screwed to the block beneath, Fig. 1.

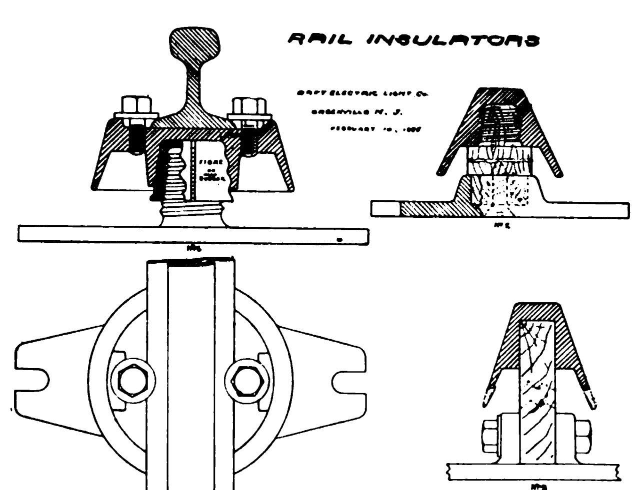
The joints were first prepared by thoroughly cleaning the plates and points of contact underneath, when thin sheets of tinned copper were interposed and the joint firmly made up. This did very well for the middle rail, but the service rails were in such bad condition that we found it necessary to adopt some other method, and I finally decided to drill the foot of each rail on one side of the track and run a continuous copper wire with a turn under the heads of special clamp bolts in the newly-tapped holes. From this ground wire and bond combined a few cross bonds were led to the other service and clamped under freshly cleaned joint plates. It only remained to get the deep rust off the third rail, which was done by hanging a heavy board to the motor so that one end would trail on the track, and after attaching a segment of coarse emery wheel to the under side it was duly weighted and towed back and forth until the desired result was attained. The "weight" at first consisted of a 160-pound man, but I regret to add that after a few trips at dead of night our friend failed to find the novelty of the situation a sufficient inducement to continue the exercise, and a resort to inanimate material became imperative. The "collector" consisted of two bronze wheels, mounted on an iron frame in the form of an X, and capable of independent contact with the rail.

The motor ran over the section so prepared nearly every night for two or three weeks with a pressure of 100 to 130 volts, and, contrary to general expectation, the insulation was not low enough at any time to permit of lighting a 75-volt incandescent lamp, in circuit to third rail with line open, except once, when a 10-inch snowstorm was followed by a quick thaw. This rough test of insulation was applied because the use of galvanometer and bridge was difficult on account of strong local disturbances, and the halcyon days of high resistance Weston voltmeters were yet in the dim future.

I think the next use of the third rail in this country was on the Baltimore and Hampden electric road, which was a trifle over two miles long, in 1885. As this was an example of commercial use, having been ordered and promptly paid for in the ordinary course of business, continuing in daily use for four years, practically on the original lines, it may perhaps be deemed worthy of passing notice. In the spring of 1885 we began placing the 25-pound rail midway between the outer rails of the track, which was situated at the side of the road clear of the ordinary traffic for the greater part of the distance, thus affording a good opportunity for the use of surface conductors; and as the railroad company had some rail in stock they were naturally anxious to use that rather than buy other material which would not be available for renewal, in case of the absolute failure, which nearly all our good friends, and especially one eminent professor of physics, confidently predicted. This latter consideration prevented the use of a special section, which I had previously designed and submitted to the railroad directors, and which bore a very close resemblance to the rail recently laid at Nantasket; in all essential particulars one may say they are identical.

Figs 3, 4 and 5 are exact copies of the original drawing, made by our draughtsman from my sketch, and dated by him Feb. 10, 1885. The specification called for insulation consisting of hard rubber or fibre for Fig. 3, and wood, prepared by baking and boiling in pitch, for Figs. 4 and 5. Fig. 3 was also designed for the Baltimore road, but Fig. 2 was adopted as being cheaper and involving less delay. The turned blocks of wood were subjected to the above described treatment, and were then driven into the dovetailed slot of the iron shoe.

The rail head was completely incrusted with scale and rust, so that some means of cleaning was necessary, and after a dismal failure to reach the desired end with a gang of men armed with new files, I rigged up a coarse emery wheel in a frame attached to free out-board journals on the armature shaft of a small motor, and ran it by belt from the motor. The emery wheel was thus free to describe a circle, of which the



Figs. 3, 4 and 5.—Daft Third-Rail Insulators.

frame and belts were radii, without changing the tension of the belt, and when placed on the front platform of one of the motors, with the emery wheel resting on the center rail and both supplied with current from the track, we found little difficulty in dressing the entire two miles in a few hours so as to afford almost perfect contact. Some fruitless efforts to make

good joints by other means were quickly followed by substantial bonding with tinned copper bonds rivetted into the feet of the rails. So laid, the center rail continued in uninterrupted use until the autumn of 1889, and during that four years two, and sometimes three motors, always with trailers in tow, made daily runs averaging 75 miles each.

It has been stated in one or two well-known books that the third rail on this road was abandoned in favor of an overhead conductor, but the latter was used only at crossings and through the village of Woodberry, in consequence of the frequent complaints of fastidious people who did not like to have their horses knocked down. The rail was protected throughout by a rough wooden guard, but the ingenuity of horses in getting down to it, despite the narrow slot, was past belief.

The potential used was 250 volts, from two compound machines in series. A few preliminary experiments with one of these machines, before the other arrived, occasioned the statement that only 125 volts was used, but save for a week or so, during the cleaning of the rail and other minor operations, the former pressure was employed from beginning to end.

That the insulation was imperfect, goes without saying, but it may perhaps be worthy of note that at no time was it low enough to appreciably increase the load, though occasions were by no means wanting when the hoods of several insulators were actually submerged during the sudden and violent storms peculiar to that region.

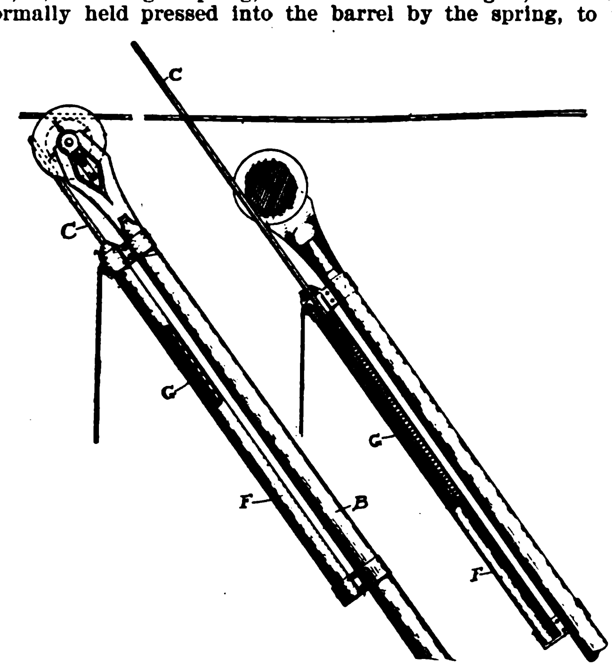
With a hooded rail and suitable wood blocks saturated with creosote by vacuum boiling, there was certainly no occasion to doubt the entire success of the Nantasket test, nor will there be serious trouble on sections of moderate length so insulated, unless much higher pressures than 500 volts be used or melting snow allowed to accumulate for considerable distances.

It now needs no prophet to read "the writing on the wall."

THE OGBORN TROLLEY FINDER.

ONE of the greatest annoyances of electric railroading is that caused by the trolley wheel leaving the trolley wire, and in not a few instances serious accidents have occurred as a consequence. A variety of trolley finders have been devised to rapidly replace the wheel on the wire, but one of the most effective which has come under our notice is that due to Mr. Harrison Ogborn, of Indianapolis, which is illustrated in the accompanying engravings.

As will be seen, it consists of a barrel, F, attached to a trolley pole of the ordinary pattern, which barrel contains a guiding rod, C, and a light spring, G. As shown in Fig. 1, the rod is normally held pressed into the barrel by the spring, to the



A Novel Trolley Finder.

lower end of which the trolley rope is fastened and thence it runs over a pulley at the upper end of the barrel. This guiding rod is projected beyond the trolley wheel by the trolley rope whenever it is drawn upon with sufficient force to draw the trolley wheel down below the overhead conductor. Should the trolley wheel jump the wire or be otherwise displaced, the trolley pole and trolley wheel will spring forward and upward and project the trolley wheel above the conductor wire. When the operator takes hold of the trolley rope to draw the pole and pulley down, the rope will first draw on the lug to which it is attached and by which the rod, C, is projected upward and outward close to and in the rear of the center of the trolley wheel. Then the trolley wheel being further drawn down by means of the trolley rope, until it is below the wire, the pole is swung toward the wire until the rod, C, comes in contact with it, by which the pulley is guided to its proper place, in contact with the trolley wire, as shown in Fig. 2. When the draft on the rope is slackened, the rod, C, is instantly withdrawn out of the way into the case, F, by the force of gravity and the spiral spring.

NEW GENERAL ELECTRIC COMPANY RAILWAY MOTOR, G. E. 1,000.

THE most prominent feature in the development of electric railway work during the past two seasons has been the remarkable increase in the number of suburban and interurban railways, the majority of them operated in conjunction with city lines. As the same cars are operated from the heart of the city into the suburban districts, a street railway motor of a capacity between that of the city and suburban car equip-

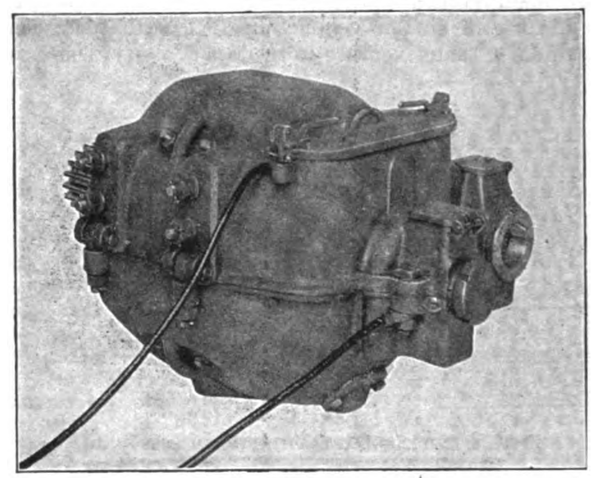


Fig. 1.—G. E. 1,000 Railway Motor.

ment became necessary, and to meet this demand the General Electric Company have designed a motor known as the G. E. 1,000, which possesses some improvements not embodied in the older types. The armature is of the usual iron-clad type with slotted core, consisting of discs of high grade annealed iron, built upon the shaft. The coils are similar in character to those on the G. E. 800 armature with the additional advantage,

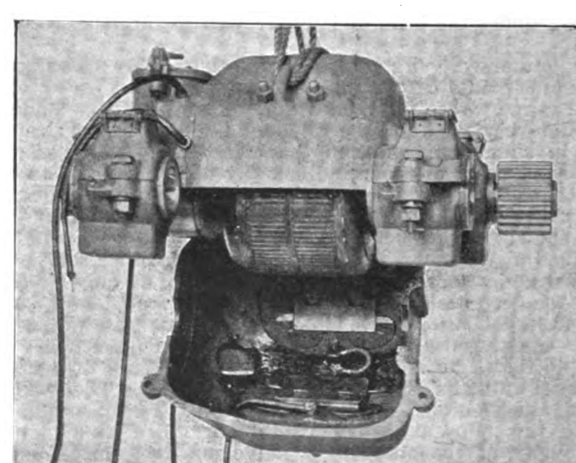


Fig. 2.—G. E. 1,000 Railway Motor.

however, of having the short commutator lead start from the center of the end of the coil to facilitate the removal of the coil in case of repair. With this change in position of the short lead, only half as many coils need be lifted when the armature is undergoing repairs. There are 93 coils in all, with four turns

per coil; the diameter of the armature is 14½ inches and its weight 570 lbs.

Two bowl-shaped castings hinged and bolted together form a strong water-tight frame of a type which has never been broken. The lower half can be lowered into the pit, being hinged at the front to the upper half suspended from the axle and a suspension yoke. A hand hole in the bottom of the frame, under the commutator allows any foreign matter to be easily removed. This opening has a cover suitably fitted so as in no way to impair the water tightness of the motor. The weight of the top field complete is 884 lbs., of the bottom field 495 lbs.

The field coils are interchangeable and four in number, secured by an extension of the pole piece secured in turn by two bolts passing through the frame. One particular advantage of having four coils is that any heating is distributed over a greater surface.

The commutator is constructed without bolts, the clamping ring being held in place by a ring nut and no chance given to oil or other substance to work itself underneath the segments. The surface of the commutator is grooved where the commutator leads are connected in such manner as to form an ear. The advantage of this in case of repair to the armature when removing the leads is obvious. Ninety-three bars of hard drawn copper, with one-inch allowed for wear are used. The diameter of the commutator is 8¼ inches.

The brush holder is a modified form of that used in the G. E. 800, the brushes being held radially, and the yoke being treated with a special insulating compound with enamel finish to insure cleanliness and freedom from leakage.

The gear reduction is 3.94 to 1 and consequently gives a low armature speed with its advantages.

The suspension of the G. E. 1,000 motor is somewhat similar to that used with the W. P. 50, but differs from it in that the bar is bolted to the nose of the motor and its ends carried backward toward the axle and attached to the truck frame at points in line with the armature shaft. As this axle is virtually the centre of weight of the motor, the suspension balances the motor, and gives an effect equivalent to the side bar suspension. This method is termed the "yoke" suspension. The yoke supporting an ordinary church bell is a comparison in kind, but not in degree since the church bell is only partially balanced while in the "yoke" suspension the same idea is carried out to a perfect balance. The axle bearings are relieved of the greater part of the weight, and the hammer blow on tracks reduced to a minimum. The motor practically rests upon springs. The total weight of the motor is 1,950 lbs.

The accompanying diagram illustrates graphically the performance of the motor, showing the speed, horizontal effort and efficiency. The efficiency curve is especially worthy of note indicating that the efficiency runs above 75 per cent. between 20 and 100 amperes. The horizontal effort is also shown to increase almost exactly in direct ratio to the current applied.

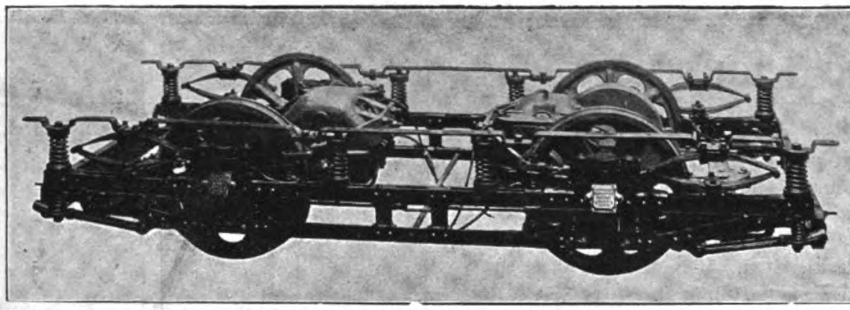


Fig. 3.—G. E. 1,000 Railway Motor on Truck

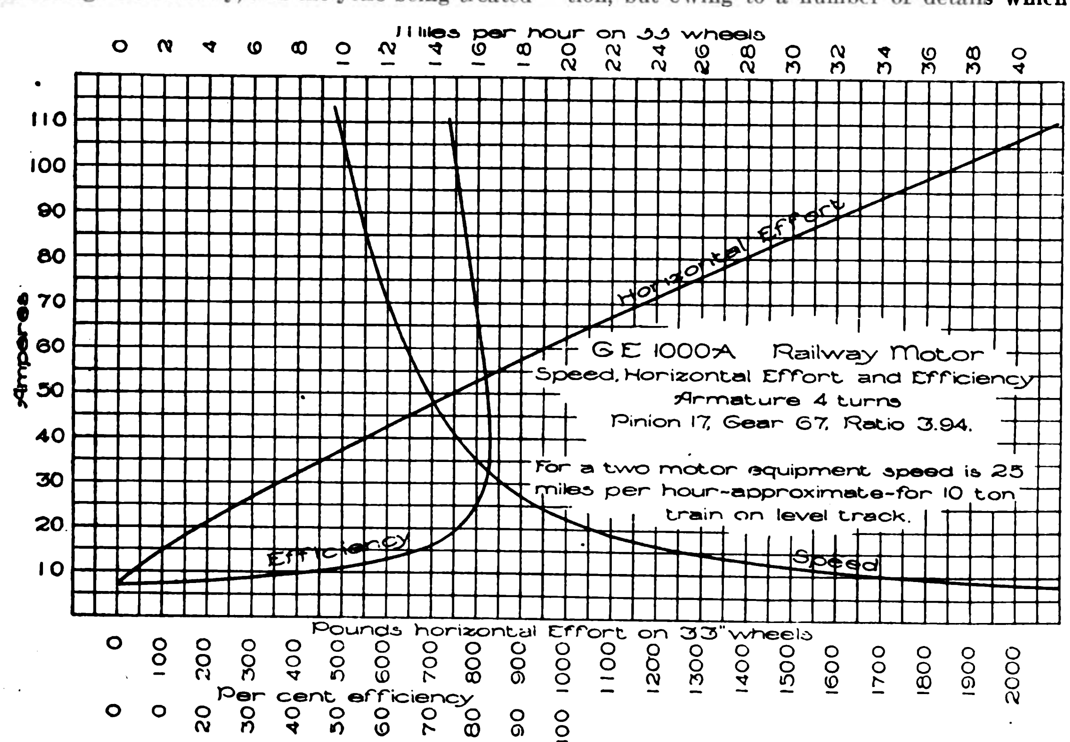


Fig. 4.—Curves of Efficiency, Speed and Horizontal Effort of G. E. 1,000 Railway Motor.

PENNSYLVANIA R. R. TO POSTPONE ELECTRICAL EXPERIMENTS.

It is stated by the Philadelphia "Press" that in all probability it will be some time before the Pennsylvania Railroad Company does anything further with electricity. It now has one line, that from Burlington to Mount Holly, in operation, but owing to a number of details which have not been supplied by the electrical apparatus manufacturers the test which was to have been made some time ago has been delayed. This road is giving satisfaction, as far as the service goes, but owing to there not being enough traffic to run the trains at more frequent intervals the cost of operating is greater than it would be if the service were greater.

There was considerable talk last year about the company

making the Camden and Atlantic Railway a trolley road, and the matter was so far discussed by the directors and officers of the company that an estimate was made of the cost of operating an electric road from Camden to Atlantic City. It was found that if the present system of electricity was adopted that the cost of operating would be greater than if the road were operated by the old steam locomotive, unless the trains were run at frequent intervals. It was also found that if the trains were run every half hour that the cost would be greater than it is now.

Electric Lighting.

THE KINCAID ARC LAMP REFLECTOR.

In street lighting it is required that the streets only be lighted, and the remainder of the light which shines upon the interiors of the blocks, or would, were it not for trees, houses, or other obstructions, and which represents the greater portion of the light, is practically lost. It is quite evident that if this wasted light could be directed upon the streets, the degree of illumination as well as the range would be greatly extended.

To accomplish this purpose Mr. W. H. Kincaid, of Santa Barbara, Cal., has invented a special arc lamp reflector, the nature of which will be readily understood by an inspection of the plan view, Fig. 1. This type is adapted to a lamp intended to light two streets intersecting at right angles. Should the streets intersect at any other angle the reflectors are set accordingly. In cases where a street branches, only three reflectors will be required.

The engravings, Figs. 2 and 3, show the reflector complete when closed and open, respectively. The reflecting wings are silvered or nickeled metal plates fastened to the curved supports. These supports are shaped to a parabolic curve, excepting about an inch of each end, which is curved in such a manner that the rays of light from those parts of the reflectors will be scattered. The object of this is to light the triangular shadows that would otherwise exist near the lamp; the distance not being great, a small amount of light will suffice. The reflectors with their curved supports are fastened to two semicircular curved arms hinged one at each end of a curved bar, which latter is clamped to the lamp frame.

To the back of each reflector is hinged a light metal frame holding a sheet of glass extending across to the reflecting face of the adjacent reflector. This is to protect the arc from the wind.

A suitably constructed ground glass half globe (not shown)

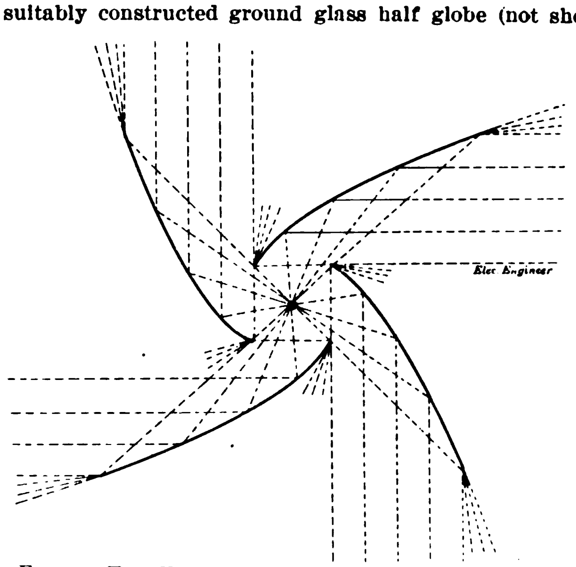


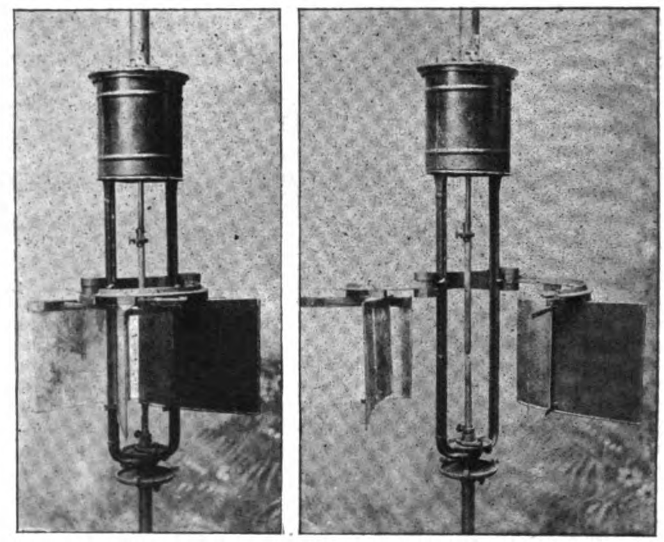
Fig. 1.—The Kincaid Street Arc Lamp Reflector.

is held by the globe-holder close up under the reflectors, the object of which is to diffuse the light and to tone down the shadows under the lamp cast by the lower edges of the reflectors. These reflectors can easily be adapted to double carbon lamps.

The model which the inventor used was roughly constructed of wood and tin. The lamp to which it was attached was hung in the center of two intersecting streets at a height of about eighteen feet. Disinterested parties stated that they could tell the time with greater ease on a watch, at two blocks, with the reflectors than at one when the reflectors were opened out, letting the light shine out in the ordinary and natural way.

Its advantages are that it can be attached to any of the single or double carbon non-focusing arc lamp in use at present, and without making any alterations in the arc lamps or frames.

Alternating current arc lamps may be employed, using a re-



Figs. 2 and 3.—The Kincaid Street Arc Lamp Reflector.

flector above the arc to throw the light down. High candle power incandescent lamps, having straight filaments, may be used, in which case it will be unnecessary to open the reflectors, and the glass windows.

STEEL PIPE FOR INTERIOR CONDUITS.

BY REGINALD PELHAM BOLTON.

In an editorial in The Electrical Engineer of July 15, respecting the new rules of the New York Fire Department, reference is made to the use of plain iron pipe with lead covered conductors as being so expensive a method of construction, that doubt is expressed if any one will employ it.

I am now doing so upon the installation of the Bowling Green Office Building, in New York, and find the result very satisfactory, as well as economical. The net difference in cost between this construction and the interior conduit with ordinary insulated wire is considerably in favor of the former.

I wish to point out, however, that in making this, the first decision to employ the new construction in this city, I am very clear as to the necessity for strictly high-grade materials, especially in the piping. The term "plain iron" pipe is very misleading, inasmuch as butt-welded iron pipe is almost invariably found to have rough scaleing, and a fin inside at the joint. I specify steel pipe, which can now be obtained free of fins, and demand that it shall be practically free of scale, and furthermore, insist on the whole being dipped into paint, inside and out.

It happens that in steam practice, steel pipes are obnoxious, as upon application of steam pressure they throw down the scale and become clean inside, and the curious result follows that that feature which is objectionable for steam work is precisely what is best for the conduit work. It is, therefore, greatly to be hoped that electricians will not attempt the use of common iron gas or steam pipe on conduit work, or the whole system will again be brought into discredit and confusion.

I have for a long time pointed out the inherent difficulty connected with the interior conduit, of its "sweating" under steam temperatures, and have urged the adoption by the Board of a much higher temperature test than is even now adopted. I maintained that under their regulation the conduit may be kept away from actual contact with hot pipes, yet it is impossible to avoid the running of conduit in heated and close places, in which the long continued high temperatures will soften the insulation, and, besides this, there is no power, ex-

cept rigid inspection, to prevent steamfitters, who care for neither God nor man, from running their heat pipes onto conduit lines. Therefore, any temperature test less than 210 deg. F. will leave matters where they are.

The Interior Conduit and Insulation Company deserve every credit for their efforts in the direction of high class work in the past, and it is with much regret that I see their material passed over, but the difficulties I refer to are real. I trust it is not too late to hope for further improvement in interior lining of conduits, but if it should be so, we must look for the development of high standard work along the line of hard and incombustible insulation, coupled with the use of drawn steel tubing.

ROENTGEN RAYS.

THE SURVIVING HYPOTHESIS CONCERNING THE X-RAY.

A SUMMARY of the different hypotheses concerning X-rays is given by Dr. Lodge in the London "Electrician" of July 17, in which the most recent aspect of the matter is stated as it appears in view of the latest experimental progress. The discovery that salts of zinc, calcium and especially uranium when exposed to strong light acquire the power of emitting an invisible radiation which continues after the exposure to the light, and which can penetrate aluminum and act on a photographic plate, has greatly strengthened the theory that X-rays are of the nature of ultra-ultra violet light. The uranium rays are capable of some amount of polarization and are, therefore, certainly transverse disturbances; they can also be reflected and refracted to some extent, while the X-rays can neither be reflected or refracted to any appreciable extent. Neither kind can be deflected by a magnet, nor even in a vacuum, not even after their passage through a highly electrified plate. Looking at these things in the light of a notable dispersion theory of Von Helmholtz, it has become almost certain that the X-rays are simply an extraordinary extension of the spectrum, far beyond the ordinary ultra-violet, and that the Becquerel rays are a less extreme extension in the same direction.

The dispersion theory of Helmholtz is of special interest at the present time, as it proves to be a remarkable mathematical prediction of the behavior of X-rays three years and more before their discovery. This theory shows, on electromagnetic principles, that ethereal radiations of smaller and smaller wave lengths should become more and more refrangible by matter in the molecular form, up to a certain maximum, which is, of course, ordinary dispersion; but for waves that are shorter still the refrangibility should rapidly, in fact, almost suddenly, drop nearly, or quite, to zero, thus doubling the spectrum back upon itself and giving an anomalous dispersion so great that the rays might be bent by a prism in the wrong direction for a certain size of wave. This state of things would be accompanied by extreme opacity, or absorption of the vibrations by the material molecules. If, however, waves existed of a kind still smaller, then the opacity would become less obtrusive; the refractivity would likewise remain very small—either positive or negative, perhaps—but probably negative; and ultimately, for extremely small waves of atomic dimensions, the refractivity would become nothing and the opacity very small.

In a general way it may be said that material atoms act as if they loaded the ether, so that coarse ether waves large enough to affect some dozens or some hundreds of molecules in a row, such as are the waves of visible light, would by reason of this loading be retarded, and therefore both reflected and refracted. All very coarse waves would be refracted about the same amount, but for smaller waves a new phenomenon would appear; as they got smaller the period of the waves might synchronize with some of the periods of atomic vibration, such vibration as enables atoms to emit light, and whenever that occurred a violent absorption might be expected, owing to the syntonic response or sympathetic resonance between the matter and the ether. This would have the effect at first of retarding the waves rather more, and of giving the well-known effects of ordinary dispersion, or the sorting out of waves roughly according to size, which we get in the prismatic spectrum. Or if the syntony is strongly marked, fluorescent and phosphorescent effects are to be expected from the jangled atoms; and if for this or any other reason absorption is rapid, the dispersion will be what is called "anomalous," which in this connection—indeed in all possible connections—only means unexpectedly complicated.

Push the matter further, however; assume the existence of waves smaller still, so small that they cease to evoke any vibratory response from the material atoms among which they now make their way; the ether of the interstices can hardly be appreciably loaded by the great blocks of immovable substance which now represent the appearance of the atoms, and accordingly retardation and refraction abruptly disappear together, and true absorption also nearly ceases.

To waves penetrating ethereal interstices, matter, even conducting matter, is fairly transparent; for ordinary notions of conductivity do not apply to these intermolecular spaces; electric displacements no longer excite necessary conduction currents, even in bodies which in the gross are conductors, and accordingly there is little or no dissipation of energy, and any obstruction that exists to the passage of light of this kind is of the ground-glass or turbid-medium type, a certain percentage of the energy being scattered at each obstacle in all directions, instead of being able to excite the material vibrations which we know as heat.

This is a very bare account of the matter, but it may suffice to indicate the sort of view which is now coming to be almost universally held regarding the nature of these no longer quite X-rays. The proof is not complete, and will not be till their length has been measured, but in all probability they are ordinary transverse ethereal waves, moving with the customary velocity of light, of various grades of wave length down to 10^{-8} m. in length, vibrating therefore some trillions of times in a second (a trillion being 10^{18}); and by the aid of this highest type of X-ray we may hope in the future to gain some diffractional insight into the actual structure and appearance of the material molecules among which they go.

There is not lacking indirect evidence to show that what we call atomic weight is approximately proportional to atomic bulk, i. e., that the heaviest atoms are the biggest atoms, and that the actual substance of all matter may be much more nearly of one uniform density than is commonly supposed. Grant this hypothesis, and it is plain why platinum or other dense material appears to be the easiest substance in which to excite the necessary electric atomic oscillations, by the impact of charged and excessively rapidly moving gaseous particles. It also suggests that the gas with the most rapidly moving atoms, viz., hydrogen, may be the best substance for the vacuum bulbs to contain; for these would impart their charges to the large platinum atoms in the most sudden manner. It would also be plain why dense bodies should be more turbid than rare ones, and it is not unnatural for the turbidity to be largely a matter of atomic weight, i. e., bulk, than anything else, because the ethereal interstices required for the passage of the waves would in such substances be considerably filld up.

HOW ROENTGEN DISCOVERED THE X-RAY.

An account of the manner in which Professor Röntgen made his famous discovery of the X-rays is told by Dr. Chas. Nootnagle, of Minneapolis, who was studying at the University of Würtzburg, where Professor Röntgen occupies the chair of physics, at the time the discovery was announced. Dr. Nootnagle was present at the first lecture concerning X-rays which was delivered before but a few persons. It was then that Professor Röntgen told how he had chanced to ascertain the peculiar faculty of the cathode ray of passing through substances that are opaque to what we know as light. Of course the peculiarities of the light emitted by the cathode pole of the Crookes tube have long been a subject of study and investigation by many scientists. One night Professor Röntgen was working in his laboratory with a Crookes tube, trying to fathom the mystery of the cathode rays. By chance he happened to note that a little piece of paper lying on his work table was sparkling as though a single ray of bright sunshine had fallen upon it lying in the darkness. At first he thought it was merely the reflection from the electric spark, but the reflection was too bright to allow that explanation. Finally he picked up the piece of paper and, examining it, found that the reflected light was given out by a letter "A" which some student had written on the paper with a platinum cyanide solution. Then he concluded that the invisible cathode rays must have caused the illumination of the paper. Naturally enough he next endeavored to intercept the rays, first with a book, and, afterwards, with several solid substances. He found that nothing except a lead plate had any appreciable effect upon the rays. It was then but a step further for a scientist to see if these rays to which the eye is not sensitive would affect a photographer's sensitive plate. He found that they would, thus showing that the retina of the human eye is not so sensitive as a prepared photographic plate. The shadowgraph was simply the result of the use of the sensitive plate in conjunction with rays which had passed through a solid body.

X-RAYS IN MEDICAL DIAGNOSIS.

THE GENERAL ELECTRIC COMPANY, of Berlin, has recently perfected some apparatus for X-ray work, especially the vacuum tube, so that it is possible to examine a number of peculiarities of the interior of the human body by direct inspection with the fluorescent screen. The London "Lancet" describes the results which were demonstrated before medical men representing the chief European capitals at the recent Twenty-fifth Surgical Congress at Berlin.

The screen employed measured about ten inches by eighteen inches, and consisted of small crystals of platinocyanide of barium dusted on to an adherent surface. Although the results obtained are probably capable of further improvement, still they were sufficiently good to indicate the probable value in the very near future of the X-rays in diagnosing certain conditions. They were, at any rate, far in advance of anything that has yet been achieved. By means of this new tube, which appears to afford the maximum production of X-rays, the labor and trouble of photography may be dispensed with, and a direct vision of certain abnormalities of the heart and in the chest may, as was shown in this demonstration, be gained.

The following were among the results shown: When the head was placed between the tube and the screen the thickness of the scalp was easily visible, the hair not appearing. The light penetrates the cartilages of the nose which are only visible in slight shadows. The frontal cavity and the antrum of Highmore are to be seen as distinctly lighter areas. In the neck are to be seen the shadows of the œsophagus, of the hyoid bone, and the cartilages of the larynx (the last not as distinctly as the hyoid bone), which both in rest and in movement are easily detected. If the light be thrown through the thorax from behind, the screen gives the following picture: In the middle occurs a dark broad stripe, the sternum; on both sides are to be seen horizontal shadows crossing each other, which are plainly the ribs; the lower margin of the thorax is represented by a shadow, the left side of which is pale and thin, but the right side is intensely dark. The picture is still better if the rays be thrown from the front and the screen placed behind, only in this case the vertebræ are seen, and not the sternum. The shadow line, which is constantly moved on inspiration and expiration for about three inches, is the diaphragm, and the darker shadow on the right side is the liver and the lighter on the left is the stomach.

This picture shows, further, that the diaphragm and the ribs are situated at a very acute angle with one another. Another big shadow is seen immediately above the diaphragm and in the middle of the thorax. This shadow (that of the heart) consists of an intensely dark central part with a light periphery. This movement of the heart is distinctly visible, principally at the apex, but on close examination the movement of the aorta may be noticed also. The heart shadow and movement are emphasized after a deep inspiration has been taken. If now the tube and screen be moved downward, the light is thrown through the stomach. The limits of this organ may be well seen, but the definition is far better after it has been distended by the administration of an effervescing mixture.

These results demonstrate pretty conclusively the possibility in the near future of the X-rays becoming a powerful aid in diagnosis coupled with the employment of a fluorescent screen. Already it has been fruitful in not only confirming previous methods of diagnosis, but in affording means of ascertaining with some precision certain symptoms which by methods now employed would not be indicated. The movements of a complex joint, such as the carpus, were clearly seen, and will throw a new light upon surgical anatomy.

PHYSIOLOGICAL EFFECT OF X-RAYS.

The following dispatch from Berlin was recently printed in the New York "Journal":

"Dr. Markuse, whose 'interior' has been photographed thirty times within the past twenty days by the Röntgen process, has lost all of his hair as a result and his face has assumed a brownish color. The skin has peeled off his breast where the Hittorff instrument nearly touched it, and on his back what was first a sore finally developed into a bleeding wound, surrounded by burnt looking cuticle. The victim is exhausted."

MR. CHARLES R. BARNES, of Rochester, has been appointed by the New York State Railroad Commission as consulting electrical engineer and expert to the commission. This position was created by an act of the last Legislature and the salary is fixed at $3,000, with traveling expenses.

MISCELLANEOUS.

THE THERMO-TROPIC BATTERY AND A NEW METHOD OF DEVELOPING ELECTRICAL ENERGY.

BY C. J. REED.

THE Jacques "carbon consuming primary battery," as described in The Electrical Engineer of May 13, 1896, and other journals, did not seem to the writer to be a galvanic cell. A series of experiments with this cell and modification of it indicated clearly that the electromotive force was due to thermo-electric instead of galvanic action. These experiments were repeated at a joint meeting of the Chemical and Electrical sections of the Franklin Institute on May 26. A detailed account of the results obtained was published in The Electrical Engineer of July 22.

Another series of experiments undertaken by the writer simultaneously, pointed as strongly to an entirely different conclusion and to the discovery of an entirely new method of transforming heat into electrical energy. Realizing the possible commercial value of this new process the writer was not prepared to make it public at that time. For this reason no reference either to these experiments or the conclusions to which they point was made in any of the communications heretofore published.

The new process of transforming heat into electrical energy is an exceedingly simple one and requires for its exhibition only a piece of wire, a galvanometer and a Bunsen burner. A piece of copper wire two feet long and one-eighth of an inch in diameter is well adapted for this purpose. The arrangement is shown in Fig. 1.

The wire is bent into a nearly circular loop and the ends connected to the terminals of a galvanometer or voltmeter, G. Two blocks of wood, W, held together by screws, form a suitable clamp to hold the ends of the wire firmly in position. After being rigidly clamped the wire is cut or sawed in two at the point, C. The ends are bent so as to spring together and fit as closely as possible.

The ends are then separated and heated to a red heat while exposed to the air. In this manner a thin film of oxides of copper is formed over the ends of the wires. The oxidized ends are then allowed to press together and the flame of a Bunsen burner or blow-pipe is applied to one of the wires at B, as close to the junction as possible. The other wire is kept cool. A strong electric current flows through the circuit in a particular direction. If the flame be transferred from B to A, the direction of the current reverses.

The thin film of cupric oxide may be replaced by a film of any conducting oxide or salt not decomposed by the flame. Fused caustic alkalies serve the purpose well. With the arrangement shown in Fig. 1, using copper wires, an electromotive force of from 0.2 to 0.4 volt may be obtained.

With brass, iron and other metals similar results may also be obtained. The electromotive force obtained by two copper wires is at least 100 times as great as could be obtained from a thermo-electric junction composed of any two of the abovenamed metals.

When copper wires or plates are used the hot wire acts as the zinc plate and the cold wire as the copper plate of the Daniell cell. With iron wires the hot wire acts as the copper plate and the cold wire as the zinc plate of the Daniell cell.

It is not necessary that both wires should be of the same metal. Any two pieces of metal may be used and even carbon and a metal. The best results are apparently obtained from the best electric conductors, and it seems evident that the development of electric potential in this apparatus is due only to the flow of heat across the surface of contact and across the film of metallic oxide or metallic salt intervening between the adjacent pieces of metal. To distinguish this process of transformation from the thermo-electric process, the term "thermotropic" suggests itself as a suitable name.

Fig. 2 shows a more efficient form of apparatus. It consists of a strip of sheet copper held in a horizontal plane in the flame of a Bunsen burner and heated to a red heat. Against the upper surface of this sheet is firmly pressed one end of a stout copper wire, the wire and sheet being both connected by suitable wires to a galvanometer. Care must be taken to allow no other heated metallic junctions in the circuit unless they are soldered or welded junctions.

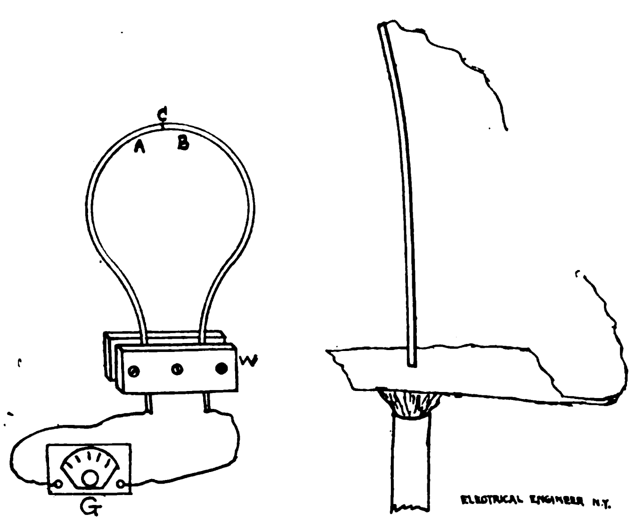
The development of electrical potential by the passage of heat from one conductor to another through an intervening electrolyte is a process more nearly resembling galvanic action than thermo-electric. While the efficiency of this method is undoubtedly limited by the second law of thermodynamics, it has not the other limitations of the thermo-electric method, and has the advantage of enormously greater electromotive force

and of being favored instead of retarded by great heat-conducting power in the metals used.

The very high electromotive force, the reversibility of direction and the development of electrical potential from a junction of two pieces of the same metal, all prove that the transformation is not thermo-electric in the sense in which that term has always been used. The reversibility, the development of electrical potential from two pieces of the same metal and the opposite effects given by copper and iron, all show conclusively that the electrical energy does not originate in chemical action. There is, therefore, only one inference left, namely, that the transformation results in some way from the flow of heat across the thermo-tropic junction.

It is generally recognized that conducting compounds are conductors only as electrolytes. We should, therefore, expect the current in this apparatus to have an oxidizing effect on one of the copper wires and a reducing action on the film of oxide, that is, at one surface there will be oxidation and at the other reduction in an equal amount. The amount of this oxidation and reduction will be the electro-chemical equivalent of the current. This chemical action does not evolve energy and does not produce electric current, but is the result of the electric current passing through the electrolyte. In the experiment with copper wires described above, the evidence of this electrolytic action is very marked. That the same electrolytic action takes place in the Jacques battery, there can be little doubt, as suggested by the writer in The Electrical Engineer of May 27, it having been found in the tests made by Messrs. Stone and Webster that an amount of carbon consumed was practically equivalent to the current.

In discussing the nature of the action that takes place in galvanic and electrolytic cells, it is to be regretted that there is a careless tendency at the present time to confuse the galvanic



FIGS. 1 AND 2.—THE REED THERMO-TROPIC ELEMENT.

cell and the electrolytic cell. The two are very much alike, but also very different. In both there are always two simultaneous chemical reactions, one of which takes place at each terminal of the electrolyte. In all cases these two reactions are each electro-chemically equivalent to the current, both in the galvanic and in the electrolytic cell. In either case a metallic substance may pass into the electrolyte, or be deposited from the electrolyte, or be deposited from the electrolyte, or both may occur simultaneously.

There is one respect, however, in which a galvanic cell always differs from an electrolytic cell. The galvanic cell always evolves energy and is spontaneous in its action, that is, the sum of its chemical reactions is exothermic. The electrolytic cell always absorbs energy and is never spontaneous; that is, the sum of its chemical reactions is either endothermic or athermal.

If an electric current be passed through a solution of cupric sulphate between copper electrodes, an electro-chemical equivalent of copper will be deposited from the electrolyte on the cathode and an equal amount of copper will pass from the anode into the solution. The oxidation and reduction of equal amounts of copper cannot either evolve or absorb energy, unless we admit that energy may be either created or destroyed. The quantity of copper oxidized or reduced in this case can only measure the current that has passed through the electrolyte. Energy has been transferred from one copper plate to another, but none of it has been evolved from the cell. The only energy transformed in such an action is the amount expended (absorbed from without) in forcing the current through the resisting medium (electrolyte), and is, of course, measured by the product of the current and electromotive force between the copper electrodes. As this reaction is not exothermic, but absorbs energy from without, it is electrolytic and cannot take place spontaneously. In other words, two chemically pure copper plates placed in a solution of a copper salt could not evolve electrical energy or constitute a galvanic cell. Similarly two zinc plates in a solution of zinc salt could not constitute a galvanic cell.

If, on the other hand, a copper plate be immersed in copper sulphate and a zinc plate in zinc sulphate, the two solutions being separated by a porous partition through which they may slowly mingle, we have a cell which may be made to either absorb or evolve electrical energy. It may act as an electrolytic or a galvanic cell. If an electric current be passed through the cell, the zinc plate acting as cathode, an electro-chemical equivalent of zinc will be added to the zinc plate and an equal electro-chemical equivalent of copper will go into solution from the copper plate. The sum of these reactions is endothermic and the energy absorbed is equal to the difference between the formation heats of equivalent amounts of copper and zinc sulphates. This amount of electrical energy is transformed into chemical energy and the action of the cell is electrolytic. The electromotive force required to do this work will be added to that required to drive the current through the resisting medium.

If we remove the external source of current and connect the copper and zinc plates by a conductor, these reactions spontaneously reverse. The zinc passes into solution and an equivalent amount of copper is deposited on the copper plate, both being electro-chemically equivalent to the current that flows through the circuit. Here an amount of energy is evolved as electrical energy, exactly equal to the difference between the formation heats of the copper and zinc sulphates. The action of the cell is exothermic and spontaneous, that is, galvanic.

In the thermo-tropic junction described above we have two pieces of copper joined by an intervening film of copper oxide acting as an electrolyte. Copper is reduced on one surface. An equal amount of copper is oxidized on the other surface. But no energy is evolved by these reactions and, therefore, the transformation is not galvanic.

The same argument applies with the same force to the Jacques battery. Dr. Jacques did not state the direction in which the current flows in his cell. Assuming that the carbon acts as the zinc plate of a Daniell cell, it will be oxidized by an amount equivalent to the current flowing, whether the action is electrolytic or galvanic. The only constituents of the electrolyte (sodic hydrate) that can be reduced are sodium and hydrogen. We may determine the energy of this cell, therefore, on either of two suppositions, (1) that hydrogen is liberated; (2) that sodium is liberated. But the liberation of an amount of either hydrogen or sodium that would be electro-chemically equivalent to the carbon oxidized would require the absorption of much more energy than the combustion of the carbon would evolve. The action of the Jacques cell is, therefore, highly endothermic and electrolytic instead of galvanic. The chemical reactions of this form of cell are necessarily very wasteful of energy and are opposed to the electric current. All the energy evolved from the oxidation of the carbon and the additional amount absorbed which is necessary to reduce either the hydrogen or the sodium, is wasted, since the reduced hydrogen or sodium, on which this work has been expended, is all lost.

The possibility of a galvanic or electrolytic cell in which oxidation may take place without equivalent reduction, is not worthy of discussion. We might as well expect to find in mechanics a shaft with only one end.

ELECTRICAL DEFENCES AT BULUWAYO.

The work of the electrical engineer is very much in evidence in Buluwayo, which owes its present safety to the efficiency of the electrical devices adopted for its defense against the Matabeles.

Within four days after it was decided to "go into laager," telephone lines were run from the main laager to the various outposts, namely, observatory, hospital, and headquarters' office, and were in perfect working order. Circuits had also to be rapidly laid for the dynamite mines. These mines were necessary for the protection of the northeast and east sides of the laager, which were considered very weak on account of the formation of the ground, and the protection afforded to the enemy by the houses. The ten mines were laid from 200 to 400 yards from the center of the laager, at an angle which, while calculated to do the greatest damage to the enemy, would be the least likely to throw stones or rubbish into the laager. The mines average about 150 feet long by 3 feet wide and 2 feet deep. The dynamite was laid in canvas along

the bottoms of the trenches and the wire connected with the top of the Market Hill building, where the local electrical engineer is stationed at night.

A searchlight has been put in the crow's nest on the building, and, by its aid, the engineer can command a good view of every bit of land around the town. The Matabeles nearly always choose the hour before dawn for their attack, but at Buluwayo, thanks to the searchlight and the telephone, a night surprise is impossible.

CONTACT RESISTANCE.

BY CHARLES WIRT.

REFERRING to the results given under the heading, "Phenomena of Commutator Resistance," in The Electrical Engineer of July 8, I think it worth while to direct attention to the great difference existing in the case of contact resistance between surfaces at rest and in motion. Contact resistance is an important subject on which very little information has been published. The article quoted asserts that in the case under consideration (contact between surfaces in motion), pressure has but a slight effect on the contact resistance.

The writer carried out a set of rather crude experiments relating to contact resistance between surfaces at rest in the Edison Laboratory a few years since. The apparatus consisted merely of a pair of circular contact blocks of red brass, 2 in. diameter by 1 in. thick, with means for measuring the contact resistance and pressure. The potential difference at the contact was measured by a Kelvin galvanometer previously calibrated and connected from block to block, using measured currents of a few amperes sufficient to give a suitable deflection. The facts deduced were as follows:

1.—With pressures between 25 and 250 pounds per square inch resistance varies nearly inversely as the pressure.

2.—The total pressure remaining constant, reduction of area does not alter resistance within wide limits.

3.—Pressure and area remaining constant, variations in the perfection of fit between the surfaces produces slight, if any, change in the resistance.

4.—Clean petroleum oil placed between the contact surfaces does not greatly alter the resistance.

5.—Clean petroleum oil mixed with pure graphite to the consistency of cream does not greatly alter the resistance.

6.—A washer of thick tinfoil (pure tin) interposed between the contact surfaces, gave a total resistance for the double contact not greater than the single contact of the blocks with each other, except with the lighter pressures.

No time tests were made. During the experiment, the two surfaces were fitted until the lower block could be lifted by the upper block by suction. Ordinary care was taken to exclude dust. The slight effect of oil on the resistance is surprising, as with well-fitted surfaces and only moderate pressure, it might be expected that a continuous film of oil would interpose between the plates. It would appear that actual contact between the surfaces with moderate pressure, even with well-fitted surfaces, is at a few points only; that increase of pressure brings more points into contact in proportion to the pressure; also that the actual points of contact are able to displace the liquid film.

A careful quantitative study of this subject would be of great interest and practical value. In all electrical connections not soldered, it should be remembered as a useful rule of thumb that conductivity depends within wide limits not on area of contact, but on pressure. This is at variance with practice, but is undoubtedly true.

Large surface of contact is of value, in switches for instance, for giving increased radiating surface and proper conductivity without undue pressure per unit of surface area; that is to say, in switches while conductivity might be secured with less surface than is now the usual practice, under sliding motion such pressure would give increased tendency to cut. In bus-bar joints, and similar cases of joints carrying large currents, where the conductors are ample, if a heavy pressure can be secured and maintained, the area of contact may safely be reduced to the amount required by mechanical considerations. It is also probably true that in such joints the interposition of a washer of pure tin, not too thick, is of advantage in protecting joints from the effects of corrosion.

BORIDE OF IRON FROM THE ELECTRIC FURNACE.

Moissan has announced a new product from his experiments with the electric furnace. He has prepared a considerable quantity of it, and has examined its properties. Those who are interested in these experiments will find them in the "Bulletin de la Société Chimique de Paris," 1895, p. 956. He says that in the electric furnace a current of 300 amperes and 65 volts may be made to produce a large quantity of the compound within the space of five or six minutes, if fragments of iron be placed in a boron-brasqued crucible; but the temperature must not be excessive, as crystalline boride of carbon will also be formed.

ELECTRIC REPULSION.

BY PROF. I. THORNTON OSMOND.

ALL text books on electricity state, as a law, that "like charges repel!" But is there any such thing as electric repulsion in the sense of a mutual force action of separation? It is true that two bodies bearing like charges move apart, if free to do so. Naturally, the first explanation was to conceive a repulsion, and this important idea immediately crystallized into a law that has endured and has permeated all electrical literature, and now adds to the difficulties of electrical studies a needless complication of error.

Will not the next author who writes, or who thoroughly revises, a work on electricity omit the false doctrine? Let him follow some such method of treatment as here outlined:

(1) In any operation of electrifying there are always two (or more) bodies having electrification of different kinds.

(2) Whenever an electrified body is brought near other bodies, the latter have the opposite kind of electrification on the parts toward the former.

(3) Between bodies of unlike electrification there are lines of force that tend to shorten and so draw the bodies together, if one or both be free to move.

(4) Two bodies of like electrification and near together are drawn apart because each has lines of force drawing it to other bodies of unlike electrification, but has no lines drawing it in the direction of the other body of like electrification.

By thus bringing to the front, or second place, the fact that every charged body is connected by lines of force (that tend to shorten) to others having unlike charge, all need for a repelling action between like charges vanishes; electric force, like gravitation force, acts only attractively. Gravitation was formerly thought to act as repulsion on certain states or conditions of matter, to account for the moving apart of the earth and bodies that rise in fluids, as smoke in air, wood in water, etc. An advance in physical knowledge has caused this false doctrine of gravitation to pass out of science. Let "like charges repel" so pass.

Is it true that "like magnetic poles repel?"

RUBBER TREES IN FLORIDA.

Those familar with the southern portion of Florida are aware of the fact that the rubber tree is indigenous here, and grows in greatest profusion on both coasts south of a line drawn west from New Smyrna. Many large trees grow on the east coast.

To the natives countless numbers of immense rubber trees are known, but, as their usefulness has not yet been developed here, they are very little noticed.

On the west coast the trees are abundantly prominent, and are an open bid for the people of Florida to investigate their value. At this time, when the people are looking for new avenues in natural products of the soil to replace the orange culture, it would be reasonable to suppose that they would utilize the wild rubber tree. On any of the keys along the coast one could find a rubber plantation or estate in an advanced state of growth.

At Anna Maria Key, says the "Daily Florida Citizen," at the entrance to the harbor, Col. John R. Jones has a place upon which is one of these trees, with five separate trunks, similar to a banyan tree. The largest trunk is eleven feet in circumference; the others measure twenty-eight, twenty-seven and eighteen and fifteen inches, respectively. When the tops of these trees become too spreading, they send down a sucker, which takes root and assists in the support of the branches. Such a tree as mentioned above covers a large area, and would afford a good revenue were its great flow of sap utilized.

Colonel Jones, on April 14 last, planted a little rubber nursling eighteen inches in height. On the 14th ult. that tree stood five feet ten inches high, showing with what rapidity they grow in their wild state without cultivation.

A NEW TYPE OF THREE-PHASE ARMATURE.

At a recent meeting of the Elektrotechnischer Verein, of Berlin, Herr Dolivo-Dobrowolsky showed a new type armature for three-phase motors. The armature resembles a compact and massive drum, the surface of which is provided with a large number of small radially cut grooves parallel to the axis. Into these grooves are pressed copper strips, which extend at both ends over the edge of the drum, and are there connected to copper rings. Herr Dobrowolsky states that this construc-

tion is electrically equal to the old one of the Allgemeine Elektricitäts Gesellschaft, which consisted of laminated iron, through which insulated copper bars are led.

ELECTRICAL SOAP.

A battery has been patented by Mr. Herbert E. Rider, of New York, consisting of a source of electrical energy placed inside a cake of toilet soap. The device is intended for curative applications of electricity to the human body. To use the language of the inventor, the invention is based on the fact that the chemical decomposition of soap is such that when dissolved in water it produces a liquid having an exciting effect upon certain metallic electrodes placed in proximity to form an electric battery. The arrangement of the electrodes is such that they may be reached by the solution formed in the use of the same, and provided with terminals on the exterior of the soap through which the electric current is transmitted to the person of the user. The elements of a simple galvanic battery are used and the effect of the current is intensified by the addition of an induction coil. Next!

THE DIELECTRIC CONSTANT.

A research published in the "Zeitschrift für Physikalische Chemie," has recently been conducted by F. Ratz upon the dependence of the dielectric constant on temperature and pressure. He appears to have followed the well-known method of Nernst which was first published in 1894. The constant was determined at various temperatures and pressures in the case of benzene, toluene, carbon bisulphide, ethylic ether, chloroform, aniline, amylic alcohol, ethylic alcohol, and water. The value $(D - 1) / (D + 2)d$ is a function of both temperature and pressure, the temperature coefficient increasing with the dielectric constant. The variation between the values of the constant obtained from the formula and the actual number is, for a temperature of 30 degrees, below 10 per cent., and the value of the above expression within 40 degrees changes by less than 5 per cent. The temperature coefficient is small, and in all cases negative, decreasing slightly as the temperature rises. No maximum for D is found at 4 in the case of water, and if such exists at all, it must be between 0 degree and 1 degree. In all cases the value of D is greater than A^2 obtained from refraction observations. The pressure coefficient is small and positive, so that it follows that the influence of temperature is greater, and that of pressure less, than the calculated effect.

THE MEASUREMENT OF VERY LARGE AND OF VERY SMALL ALTERNATING CURRENTS.

At a recent meeting of the Physical Society, London, a paper on the above subject was read by Mr. Campbell, who advocates the use of air-core transformers for measuring voltages and currents which are either above or below the range of the instruments available.

If an attempt is made to measure the current in the primary of an air-core transformer by observing the voltage on an open circuit secondary, it is found that the readings depend on the frequency. In order to overcome this difficulty the author uses a closed secondary with a very high inductance. In this case the primary current is proportional to the secondary current, which latter may be measured by an ammeter. The author has also investigated the case of transformers with iron cores, and of which the inductance of the secondary is large. In the case of a ring transformer with a closed magnetic circuit, if the load on the secondary consists solely of a Kelvin 100 ampere balance of very low resistance, the ratio between the primary and secondary currents is practically constant. With an open magnetic circuit transformer, however, this is not found to be so, as the ratio between the primary and secondary currents varies considerably with the frequency.

GRIFFITHS' RESISTANCE BOX.

A novel resistance box has been exhibited before the London Physical Society by its inventor, Mr. Griffiths, which embodies the following features: (1) It permits of all the coils being compared with one another without the use of standard coils, and with great ease and rapidity. Hence it is sufficient at any time to compare any one of the coils with a standard to obtain the correction to be applied to all the coils. (2) The bridge wire can be calibrated by means of the box itself. (3) The temperature of the coils can be accurately determined, since they consist of bare platinum-silver wire wound on mica and immersed in an oil bath, which bath is kept stirred. (4) The resistance of the leads from the box to the object being tested is eliminated, as well as any error due to a change in this resistance with temperature. (5) The coils are arranged according to a binary scale, and the author claims that it is possible to measure resistances up to 105 ohms to within 0.000001 ohm. (6) All the coils, after being adjusted, have been heated to redness and allowed to cool slowly, so that all strain has been removed from the wire. (7) By having a separate pair of blocks for each plug, it is impossible for the insertion of one plug to affect the fit of a neighboring plug. The plugs themselves are so made that no part of the plug is wider than the top of the hole, and so it is impossible to wear a "shoulder" on the plug.

ELECTROLYTIC MOLYBDENUM BRONZES.

Stavenhagen and Engels describe in the "Berichte der Deutschen Chemischen Gesellschaft" some molybdenum bronzes which they have recently succeeded in preparing. Amongst these, there is one which bears a great resemblance to tungsten bronze, and is formed by electrolyzing fused acid, sodium molybdate. The fusion is performed in a platinum crucible, with a current of 8.5 amperes and generated by three accumulators (4.9 volts) placed in series. The bronze separated quickly at the cathode in crystals, which have to be washed with boiling water and dilute hydrochloric acid. It is soluble in alkalies, in nitric acid, and aqua regia, but not in hydrochloric or sulphuric acids; its composition is found by analysis to correspond to the formula $N_2Mo_5O_{15}$.

CONDUCTIVITY OF SALTS DISSOLVED IN GLYCEROL.

Carlo Cattaneo has, during the last two or three years, devoted a considerable amount of attention to the investigation of electrical conductivity of salts dissolved in various solvents, for example, water, alcohol, and ether. He has now turned his attention to the conductivities of solutions of ammonium, sodium, zinc, barium, and ferric chlorides, and potassium bromide, and iodide in glycerol containing 25 per cent. of water at various temperatures between 0 degree and 24 degrees Centigrade. The conductivity of the various salts is, in general, greater than that of the corresponding ethereal solutions, but less than that of the alcoholic ones; the conductivity of the aqueous, alcoholic, and glycerol solutions increases more rapidly than the concentration. As the concentration decreases, the molecular conductivity of the salts in aqueous solution increases, and in ethereal solution decreases; that of the chlorides increases, whilst that of the bromides and iodides decreases, in alcohol solution, and in glycerol, the molecular conductivity of the chlorides increases, whilst the concentration decreases. The temperature coefficients are usually greater for aqueous than for alcoholic solutions; in ether, they are of approximately the same order as in water, but are negative in sign, whilst, in glycerol, the temperature coefficients have very high values. In his paper in the "Real. Accad. Lincei," 2, page 112, Cattaneo gives a table of the conductivities of the glycerol used at various temperatures, showing that it obeys the rule enunciated by Bartoli, which states that those carbon compounds which become most viscous on cooling, are those whose conductivity increases most rapidly as the temperature rises. At 18 degrees, the conductivity of the glycerol was found to be of the order of 10^{-12}.

DISCHARGE OF ATMOSPHERIC ELECTRICITY.

At a recent meeting of the Berlin Meteorological Society Dr. Schwalke spoke on the investigation of some important theories of atmospheric electricity, and added an account of experiments he had made on the dissipation of electricity by vapor. A metal plate insulated, charged to ten volts, and connected with a Thomson quadrant electrometer, discharged itself in exactly the same time when dry as when wetted with water or other easily vaporized fluid. Sprinkling with finely-pulverized quartz greatly hastened the discharge.

LETTERS TO THE EDITOR.

THE JACQUES CARBON BATTERY.—A CORRECTION.

In The Electrical Engineer of July 22, which has just reached me, I notice in my article on "The Jacques Carbon Battery" that the engraver has, in reducing Figs. 2, 4 and 5, not reduced the scale of temperature in the same proportion as the curves and time scale, thus introducing a number of apparent inconsistencies.

In Fig. 2 the temperature 238 degrees, as stated in the text, corresponds to 18 minutes, instead of 32 minutes, as shown by the engraver.

In Figs. 4 and 5 the temperature of 343 degrees corresponds, as stated in the text, to 38 minutes, instead of 65 minutes, as shown by the engraver. C. J. REED.

Philadelphia, July 23, 1896.

THE

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CONTENTS.

THE TROLLEY BASE DECISION.

NOT only those operating electric railways, but the entire electrical fraternity, is directly affected by, and will be interested in, the decision just rendered by the Circuit Clurt of Appeals in New York, involving the manufacture and use of trolley bases. Following the decision of Judge Townsend in the suit of the Thomson-Houston Electric Company vs. The Winchester Avenue Railroad Co., sustaining the Van Depoele under-running trolley patent, the Thomson-Houston Electric Company applied for a preliminary injunction against the Kelsey Electric Railway Specialty Company, of New Haven, to restrain the manufacture and selling of an improved trolley stand made by that company. It was contended by the defendant in that case that the trolley stand made by it was a decided improvement upon the trolley stands made by the General Electric Company, and that the sales made by it had been made to replace General Electric stands, which, on account of their greater height were less effective and less efficient than those made by the defendant. Judge Townsend, however, granted the injunction, holding that such a use was unlawful as being a reconstruction of the patented combination. The Circuit Court of Appeals now holds that such sales are lawful. It may be noticed that in its opinion, printed in full on another page, the court takes very strong ground against what, by implication, it believes to be a bar to all further improvement. Thus, in commenting on the character of the trolley made by the defendant company which possessed qualities not pertaining to the apparatus made by the General Electric Company, it says that a refusal to permit the substitution of the improved apparatus is equivalent to a declaration that no street railway company can be permitted to improve its stands except by the consent of the General Electric Company. The court, on the contrary, holds, in just so many words, that if a purchaser chooses, the day after his purchase, to substitute a stand which is better made and better adapted to his peculiar needs he has the right to do so.

An interesting feature of the arguments in this case was that brought forward by the complainant, the General Electric Company, who referred to the suit brought by the General Electric Company against the Davis Electrical Works, which resulted in the latter company being enjoined from repairing worn out incandescent lamps by the insertion of a new filament, but the court held this case to be irrelevant and the conditions not analogous. What the result of litigation of this kind in the future will be likely to result in may be gathered from the dissenting opinion of Judge Wallace, who goes even further than his colleagues on the bench, and who believes that the Van Depoele under-running trolley patent consists "in various combinations of parts of which a trolley stand in some form is one." If these trolley stands were originally bought from the General Electric Company, Judge Wallace believes that "they (the railway companies) have a right to repair their trolley stands, to substitute new ones for those old or worn out or to substitute a better and improved kind for those originally bought of the complainant," and any one, according to Judge Wallace, ought to have the right to make and sell the stanas to electric railways. As to the necessity for the manufacturer to inquire for what purpose the trolley base is to be used he considers the case analogous to that of a man who sells a gun or a knife who would be deemed guilty of an impertinence if he

should inquire of the purchaser whether he intended to use it legitimately. We believe that this decision will be hailed with satisfaction by all railway operators and railway supply manufacturers, and hope that it may put a salutary restraint upon the coercive methods of the Electrical Trust. It may be well also to repeat the fact that the litigation under discussion comes under the broad Van Depoele trolley patent, which had been previously sustained, the trolley base constituting merely a detail under that patent, or one of the elements of the combination. One or more such decisions on details of the underrunning trolley patent may cause this patent to go the way of many before it, that have been used for similar purposes.

THE ADVANCE IN THE PRICE OF INCANDESCENT LAMPS.

WE understand that the long-discussed agreement among the manufacturers of incandescent lamps for the purpose of arranging a schedule of prices has at last assumed definite shape, and that almost all of the lamp manufacturing companies in the country are represented in the combination. While little of the detail of this agreement has been made public it is understood that the first move of the companies will be to return to the 20-cent price for 16 candle-power lamps, which was generally in vogue about a year and one-half ago. Such an agreement, if it is not abused, must be considered a wise step for both the manufacturers and the consumers, as no one familiar with this branch of the electrical business can question the fact that for some time the price of lamps has been below a figure at which manufacturers can realize a reasonable profit, if sufficient time and skill are expended by them to make first-class lamps. About two years ago, when the fundamental Edison lamp patent expired a war of extermination was declared between the General Electric Company and all the other lamp manufacturers in the country, and from the prices of 30 to 35 cents, then current for 16 candle-power lamps, a reduction was soon made to about 18 cents, and in some cases large orders have been quoted at from 12 to 15 cents. Although these prices come very close to the actual cost of manufacture only a very few of the weakest concerns have been forced out of the business, though probably not a single concern is earning a profit. The strenous competition has had the effect, of course, of keeping the quality of lamps up to a fair standard, but there is much room for improvement, and if the quality of lamps is improved commensurately with the prices, the advance will be an actual saving in the pockets of lamp consumers. It is recognized that without some agreement between manufacturers it would be almost impossible to advance prices to where they belong, and it will be of great advantage to the consumers to have a standard price for lamps and have the competition between the companies carried on along the line of quality.

It is not generally appreciated by consumers, except central station men, that the first cost of an incandescent lamp is almost a negligible quantity in comparison with its total cost. A specific example makes this point very evident. Take the case of a moderate size isolated plant in which the cost of producing current will be about 15 cents per kilowatt hour. If a 16 candle-power lamp is burned here for 500 hours and its average efficiency is 70 watts, its operating cost will be $5.25 and its first cost, say, 20 cents, will bring its total cost up to $5.45. Another lamp of an average efficiency of 60 watts for 500 hours would cost to operate $4.50 and at the same first cost would make a total of $4.70, which would leave a saving of 75 cents to the consumer in favor of the second lamp. This is sufficient to show the great importance of quality and the relative insignificance of the first cost of incandescent lamps, and any reasonable advance should be highly satisfactory to consumers as long as the advances in price are accompanied by corresponding improvements in the average efficiency of the lamps.

Apropos of this action of the lamp manufacturers is the increased demand by consumers for a 2½ watt lamp, and of a "constant economy lamp" of 20 candle-power instead of the time-honored 16 candle-power lamp. Our readers will also recall Mr. Beggs' lamp specification which gave the lamp manufacturer a bonus for exceeding the standard laid down. All these factors point to the imperative necessity of an increase in the price of lamps for the benefit of all concerned and while combinations in restraint of trade are the bane of modern industry, the present combination is one which, we believe, will work to the advantage of both producer and consumer.

THE NIAGARA-BUFFALO TRANSMISSION.

WHAT must be considered one of the most important developments of the present year is the actual letting of the contract for the building of the power transmission line between Niagara Falls and Buffalo. This project has been so much talked of, and its practicability so often denied, that the perusal of some articles, written but a short while ago, must appear somewhat ridiculous to their authors. That this epochal undertaking involves many new questions of engineering goes without saying. The mode of transmission itself was in doubt for a long time. Underground conductors were seriously discussed in the early stages of the undertaking, but overhead conductors have been finally adopted. The description and illustrations which we give of the new line in this issue show that extraordinary care has been taken to forestall all possible elements of disturbance and we see no reason why the line should not, with ordinary care and supervision, remain in practical working order for an indefinite period. Aside from the methods of construction themselves, not the least interesting point in connection with this transmission is the nature of the first contract for the supply of power to Buffalo. This contract is made with the Buffalo Railway Company, whose steam power plant has been looked upon as one of the most economical in the country, and yet the company apparently finds it advantageous to contract for one thousand horse-power at $40 per annum, with a reduction to $36, for all power in excess of that amount. If, with a plant such as the Buffalo Railway Company possesses, containing boilers with mechanical stokers, compound engines, etc., $40 per horse-power per annum is an inducement to make a change, what may we not expect in the case of the hundreds of other plants not so fortunately situated in the way of improved steam plant? The contract with the power company calls for the erection initially of a circuit of 5,000 horse-power capacity from the falls, but we shall be greatly mistaken if the full capacity of the line is not called for sooner than even the promoters of the scheme contemplate.

A CONCEPTION OF ELECTRIC REPULSION.

ELSEWHERE we print a short note by Prof. I. Thornton Osmond, which offers a new conception of the idea of electric and magnetic repulsion. The writer objects to the law that "like poles repel" on the ground that there is absolutely no repulsive force exerted between two poles of similar polarity, and that the idea of repulsion is an unscientific view of the phenomenon which is noticed on the approach of two similar poles. We must admit the justice of his conception, however, that two poles which apparently repel each other only separate when free to move, for the reason that each is more powerfully attracted to neighboring bodies of opposite polarity than it is to the similar neighboring pole. But even accepting this theory of the behavior of charged bodies, the apparent repulsion of like charges, which is perhaps as unscientific as the old conception of negative gravitation, is so convenient that it will probably remain a "law" for the majority of electrical text books.

"THERMO-TROPIC" GENERATION OF ELECTRICITY.

WE print elsewhere in this issue an interesting contribution from the pen of Mr. C. J. Reed, in which he points out an apparently new method of generating electrical energy, to which he has given the name "thermo-tropic." In this process the electric current is developed merely by the passage of heat from one conductor to another separated by an electrolyte, which in the present case was a film of oxide formed at the junction of two pieces of metal. There are several notable points in connection with this method of generation which distinguish it radically from the action of the thermo-electric battery and from that of the electrolytic cell, all of which are clearly pointed out in Mr. Reed's paper. A feature of this new method is the remarkably high electromotive force produced by it. The fact that from .2 to .4 of a volt is obtained, which is many times that of a thermo-electric battery, suggests that this method may find some practical application, although its efficiency would, of course, be but small. It would also have been interesting to know what the internal resistance of such a couple is.

Power Transmission.

THE NIAGARA-BUFFALO TRANSMISSION LINE.

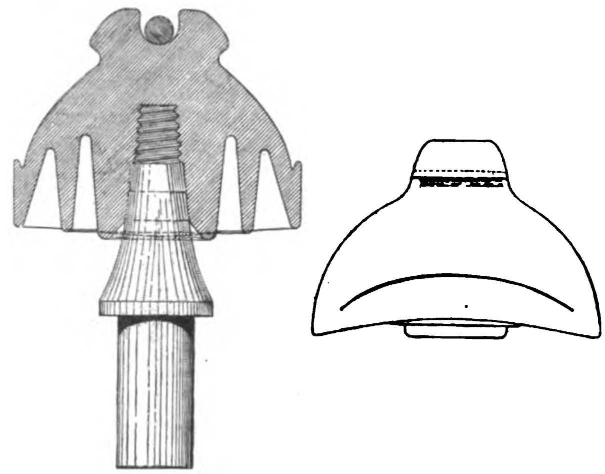
THE Buffalo Power and Conduit Company, which was organized to distribute Niagara power in Buffalo, has awarded the contract for the construction of its power transmission line between Niagara Falls and Buffalo to the White-Crosby Company, of New York. This transmission line will run from the power house at Niagara Falls along what is known as the Two-mile-line road, near the tracks of the New York Central and Erie railroads, crossing the creek at Division street, and from Tonawanda to Buffalo city line it will follow the canal banks.

The transmission line embodies a number of special features of construction, in view of the fact that it will carry very heavy wires, and will be subject to the high winds and storms of snow and sleet which the region in the vicinity of Niagara is subject to. The poles will vary from 35 to 65 feet in height, depending upon the contour of the ground, so as to maintain the wires as level as possible. Depending upon the height they will vary from 14 to 28 inches in diameter at the butt, and will not be less than eight inches in diameter at the top. They will be set into the ground to a depth of from 7 to 8½ feet, depending upon the height. All poles will be of white cedar, selected, shaved and painted.

The pole line is intended to transmit 20,000 horse-power over four circuits, of three wires each, the three-phase system having been adopted. These circuits will be erected on two cross arms, each side of the cross arms carrying three wires, as shown in the accompanying illustration, Fig. 1. Each of these three wire sections is thus intended for 5,000 horse-power transmission.

In order to make the construction as strong as possible a special form of brace has been employed, which, it will be seen, consits of a 2½x2-inch angle iron, bent in one piece. These angle irons will be secured to the cross arms by two lag screws, so as to insure a tight bearing without play, a feature which could not be secured if through bolts had been used, which, in addition, would have weakened the pole to some extent. The angle iron, it will be evident, constitutes as good a strut as it does a tie, and in this respect is much superior to the usual form of straight iron brace.

As the potentials carried on this line will be very high, a special form of insulator has been designed, capable of withstanding 40,000 volts. These insulators will be of porcelain, with triple petticiats, as shown in section in Fig. 2, and will be of the helmet form, as shown in Fig. 3. The base of the helmet measures seven inches in one direction and nine inches in the other, and the insulator will be placed with the greater length



Figs. 2 and 3.—Insulator for Niagara-Buffalo Transmission.

parallel with the line of the wires. It will thus be seen that any water falling on the insulator will run into the grooves or brim of the helmet and drop down clear of the cross arms. Icicles which may be formed will also fall clear of the cross arms.

The insulators will be mounted on 2-inch pins, and in order to increase their strength a construction has been adopted such that the body of the insulator bears for a considerable distance below the thread of the pin. This prevents the revolving of the insulator and the stripping of the thread, even with a full lateral load on the wire.

The conductors, three-quarter inch in diameter, 350,000 circular mils section, will lie in the groove in the top of the insulator, and will be tied. It will be noted that the insulator is so designed as to have the same thickness of body between the top of the pin and the main conductor, as between the pin and the tie wire when in place.

Special precautions have been taken to guard against light-

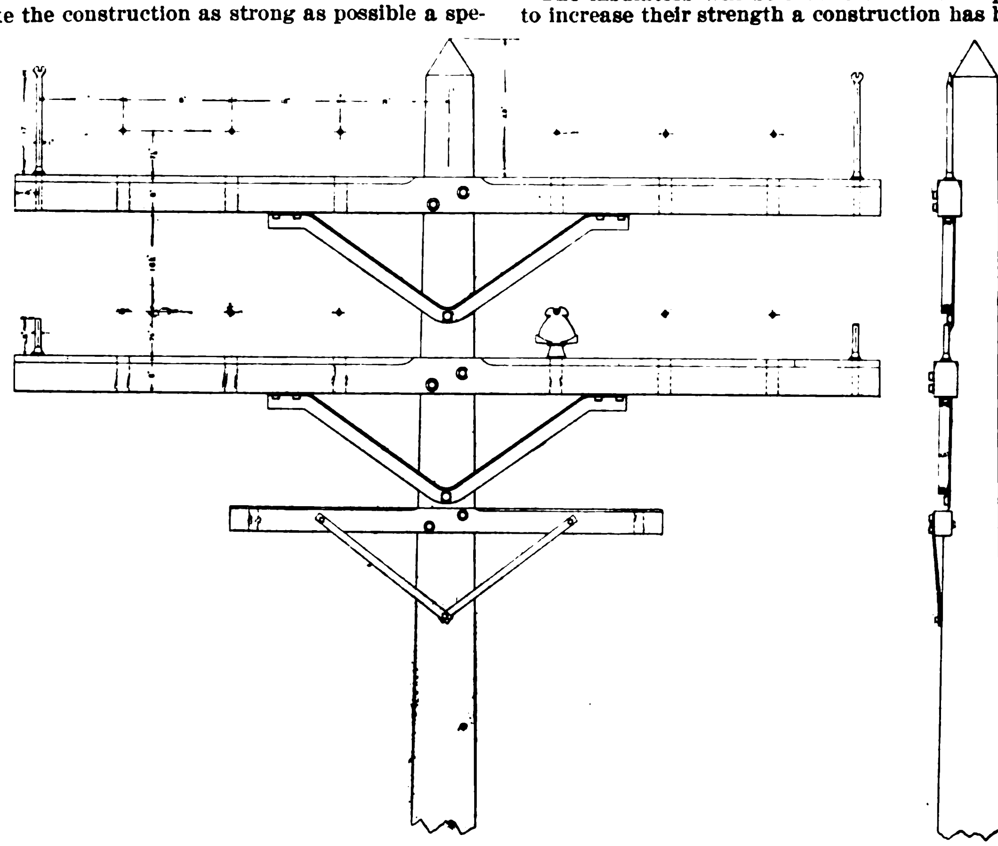


Fig. 1.—The Niagara Falls-Buffalo 20,000 H.-P. Three-Phase Transmission Line.

ning, and for this purpose the top cross arm on each pole is provided with a one-inch rod of double refined iron, forked at the top with a three-eighths-inch groove. In this groove, or channel, barbed galvanized iron wire will be run, and tied for safety. A line of barbed wire will also be run along the tops of the poles thus affording a complete protecting mantle. At every fifth pole one of the lightning arrester bolts is prolonged through the cross arm, and to this prolongation a ground wire will be attached. The ground will consist of a coil of tinned No. 6 copper wire, buried in the ground and brought up a foot above the surface, where it will be attached to the iron wire leading down from the lightning arrester pin. Iron has been adopted to lead down the poles to the grounds, as it is less likely to fall a prey to copper wire thieves.

These lightning arrester pins will also act as a guard to prevent the upper wires from falling to the ground in case the insulator should break. On the lower cross arms special iron guard pins, six inches high, will be placed, which will act in the same way to catch the wire in case of a fracture of the insulator.

Below the two main cross arms a third cross arm, six feet in length, and carrying six pins will be run, which will carry three circuits of No. 12 copper telephone wires.

The main conductors will be transposed at five points between Niagara and Buffalo, so as to avoid the effects of induction between the circuits. The contract calls for the erection of the pole line complete with three wires by November 15.

NIAGARA POWER TO RUN THE BUFFALO STREET RAILWAY.

SIMULTANEOUSLY with the letting of the contracts for the Niagara-Buffalo transmission pole line, another important contract was made. The parties to this second contract are the Cataract Construction Company, the Buffalo Power and Conduit Company, the Buffalo Street Railway Company, and the General Electric Company.

The contract which has been closed between these four companies provides for all of the apparatus and machinery necessary for the transmission, transformation and delivery of 1,000 horse-power to the lines of the Buffalo Street Railway Company for the operation of the electric cars on the various lines in Buffalo, by November 4.

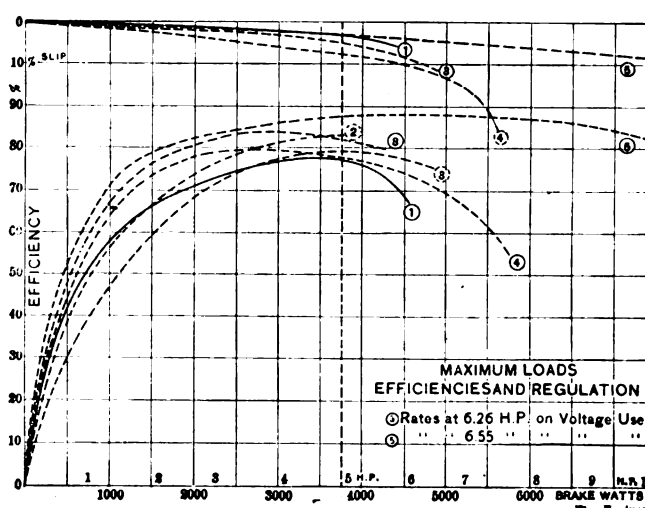
It is not the intention of the railway company to wholly supersede its present Niagara street power plant with this Niagara power, although they hope in time to do so. The Buffalo Street Railway Company produces the steam power which it is now using to run its machinery for the development of electrical power, at a remarkably low cost, and the adoption, even partially, of Niagara Falls power in the face of this fact indicates the belief of the company in the successful and cheap transmission of this power to that city. At first they will use it entirely for running the night car service of the city, and during the day they will use it in addition to the power developed in the Niagara street plant. It will be taken from the city line along the Erie Canal to a point in the rear of the Niagara street power house. The cost of the machinery which the General Electric Company is to furnish will be but a portion of the entire first cost of the undertaking. Yet this cost of machinery shows how comparatively cheap it is to get the power plant in operation after the transmission line is in operation. The contracts just closed are for about $50,000 worth of apparatus and machinery.

The contract entered into with the Cataract Construction Co., of Niagara Falls covers three transformers, which will be the largest ones ever built. These transformers will "step up" the alternating current of 2,200 volts generated by the dynamos in the Niagara Construction Company's power house, to either 10,000 volts or 20,000, as may be thought desirable. The power may be transmitted to Buffalo at either of these voltages. The transformers which the General Electric Company have contracted to furnish to the Buffalo Power and Conduit Company will reduce this voltage or pressure again to 400 volts and at this voltage the electric current will enter two 500 horse-power rotary converters which will be erected in the Niagara street power house of the Buffalo Street Railway Company. In these rotary converters the alternating current will be transformed into a direct current of 550 volts, which will be the same voltage as that generated by the large generators now used for the creation of electric power in the railway company's power house. The rotary transformers will be used in parallel with the direct current generators in the railway power house.

Considering the cheapness of the power developed by the Buffalo Street Railway Company, it is highly interesting to know exactly what this Niagara power is to cost the Buffalo users. The contract calls for the delivery in Buffalo of the first 1,000 horse-power at $40 per horse-power per annum. Should the Buffalo Street Railway Company want more than this 1,000 horse-power the price will be $36 per horse-power for the additional amount used.

EFFICIENCY AND POWER FACTORS OF ALTERNATING CURRENT MOTORS.

IN his excellent paper on alternating current motors, read before the Northwestern Electrical Association, Prof. D. C. Jackson gave the results of a series of tests carried out on eight machines of different make. The table and curves embodying these results reached us too late for publication in our last issue, but in view of their importance we print them this week.



CURVES OF EFFICIENCY OF ALTERNATING MOTORS.

Five horse-power, alternating current motors of the following American makers were available for the purposes of the tests: Fort Wayne Electric Corporation, single-phase; Stanley Electric Manufacturing Company, two-phase; Westinghouse Electric and Manufacturing Company, two-phase; General Electric Company, three-phase. A 5 horse-power three-phase made by the Allgemeine Electricitäts Gesellschaft of Germany, was also

Number.	Rated capacity, H.P.	Rating at voltage used, H.P.	Torque, in % of Full Load.			Starting current, in % of full load.	Drop in speed at full load, %.	Efficiencies, %.					Power Factors, %.					
			Max. running.	Static.	Starting.			Max. eff.	¼ load.	½ load.	¾ load.	Full load.	Max. p. f.	0 load.	¼ load.	½ load.	¾ load.	Full load.
1.	5	5	140	131	77	157	3.	77.8	55.2	70.6	77.	76.6	76.4	13.	37.5	50.	62.3	71.5
2.	5	5	100	45	44	153	..	83.8	54.5	72.5	80.5	83.8	67.5	10.5	25.5	58.	67.3	64.
3.	5	6.26	104	90	83	114	9.7	79	52.	71.9	78.9	77.	84.	74.	81.6	83.3	83.7	84.
4.	5	5	186.5	136	39.4	262	7.	79.5	62.2	77.2	79.5	77.8	82.6	15.5	44.7	62.5	73.7	80.3
5.	5	6.55	171	138.5	86.6	156	3.7	88	75.2	85	87.7	88.	78.5	6.8	27.5	45.5	59.8	70.3
6.	10	10	>147	142	137	194	4.5	82	67.	78.4	81.9	81.1	79.	15.	40.4	59.1	69.	73.4
7.	4.5	4.5	>163	232	..	357	3.7	79.1	61.	73.8	78.4	79.1	88.4	22.2	51.3	69.4	80.3	85.2
8.	5	5	..	..	..	..	4.6	83.8	65.5	80.2	83.8	82.	89.	..	52.	71.5	81.7	87.2

Note.—6, 7 and 8 were not run up to maximum load, on test.

included in the tests, and results of tests on machines made by the Oerlikon works and by C. E. L. Brown, of Switzerland, were obtained. A 10 horse-power Westinghouse two-phase was also tested. A capacity of 5 horse-power in the motors to be tested was chosen, as that may be considered to be near the average capacity of motors used in the service of ordinary central stations. The results of the tests may, therefore, be accepted as representing, for the central stations, comparative results between the average motors which they may use on alternating current systems, and the results may also serve as a basis for comparison between average conditions of operating with continuous current and alternating current motors. According to Professor Jackson, four out of the six motors tested affected the incandescent service disastrously, and showed the absurdity of attempting with them a combined service on the same circuits as the incandescent lighting in those plants where regulation and the satisfaction of the customers is considered of importance. The tests show that the alternating current motors give equally satisfactory regulation and efficiency as is given by continuous current motors, but the power factors of most of the machines are small for part load, the starting currents excessive, and the starting torques with the present arrangement of starting resistances are unduly small. The best performance of the American 5 horse-power machines lies between No. 3 and No. 5 of the tables. These machines will stand well above the others. They are about even in starting torque, but No. 5 will carry considerably the higher before dropping out of its pace; No. 5 also regulates the better and has the higher efficiency. On the other hand, No. 3 has a power factor incomparably better than any of the other machines.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST MILLENNIUM EXHIBITION.—III.

BY ALFRED O. DUBSKY,

THE larger single-phase induction motors, such as the motor shown in Fig. 13, start with a greater torque. There is only one double-width pulley and the motor starts with the belt on the loose pulley on the countershaft. The induced part —either revolving or not—has a polyphase winding; as during

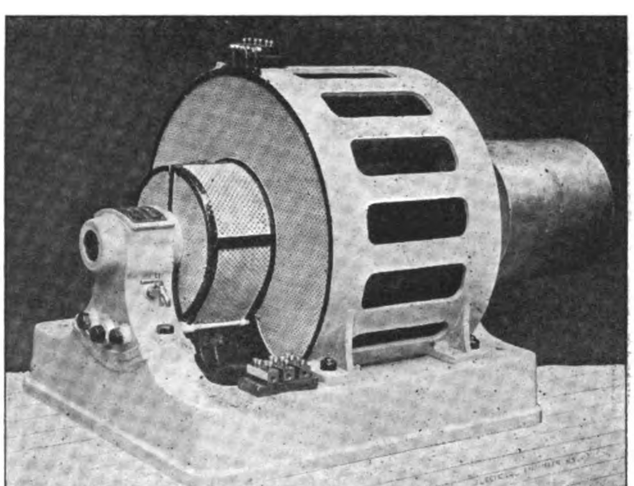
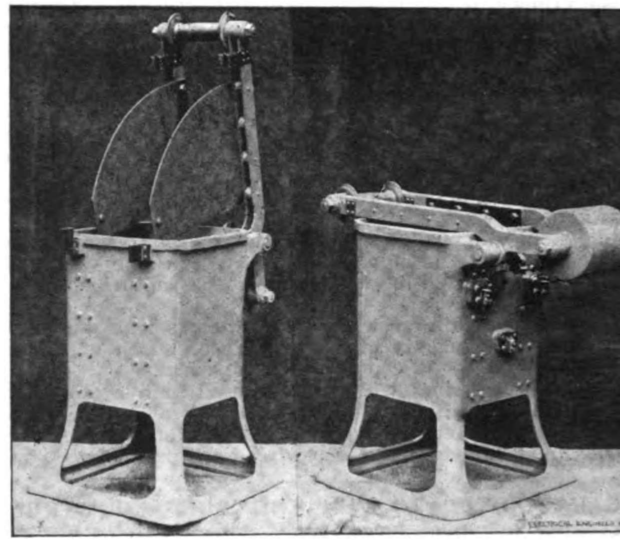


FIG. 13.—20 H.-P. SINGLE-PHASE INDUCTION MOTOR.

the start the primary works as a diphase winding, the secondary induced winding is preferably a three-phase one, as it gives a nearly equal starting torque in every position. The induced current is carried to a water rheostat, Figs. 14 and 15; by dipping the iron plates at first very little into the water, a large resistance is inserted in the secondary, which greatly increases the starting torque.

The starting current is never as large as the current during ordinary work. This is of great importance, for the reaction of the starting of a motor on the central station is of importance. The author has employed a simple way to start an induction motor of this construction, if any other motor of the same kind near at hand is already running. Referring again to Fig. 10, we see that at full speed the current flows from I. to II. In the mean time, it is quite natural that with the winding drawn in the figure the tension between I. and III. has a difference of phase of just 90 degrees from the tension between II. and III. In reality III. is the middle of the winding between I. and II.; but at full speed a voltmeter applied to the terminals between I.-III. and II.-III. will show nearly 70 volts, if the main tension between I. and II. is 100 volts. By connecting the three terminals of any induction motor of suitable size to the terminals I., II. and III. of a motor already running, the former will start under full load, as an ordinary polyphase motor.

This method is a modification and concrete application of the



FIGS. 14 AND 15.—WATER RHEOSTAT.

phase shifting transformer of Messrs. Ferraris and Arno[1]; it has the advantage that by connecting the three terminals of all motors situated near at hand, only one motor need be started with the device mentioned above; all the other motors can start with two phases. In case of a large overload an ordinary induction motor would stop; by using these connections the phase-shifting action of the running motors does not permit the overloaded apparatus to come to rest. When the slip of one motor is larger than the slip of the other motors, there is always an equalizing current flowing between the middle terminals (III., of Fig. 10), of the motors; the larger the difference of load, the larger is the intensity of this current.

Fig. 16 shows an external view of the starting apparatus of a 3 horse-power single-phase induction motor. In its interior are the ohmic resistance and the choking coil. There are three positions of the handle: "Off," "Start," and "On."

A special arrangement for the starting of induction motors is the method proposed by Mr. de Kando. It is well known that the self-induction of toothed armatures depends to some extent on the number of the teeth. The primary winding of any polyphase motor can be divided into two different parts, so that the number of the teeth would be different for the

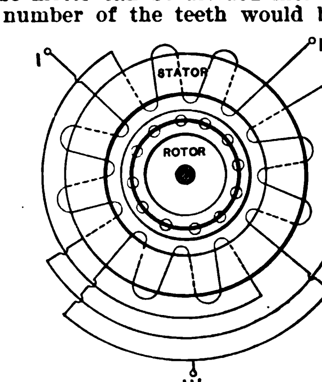


FIG. 10.

unit of length; the value of the self-induction would be different in the two windings. By sending a current in both coils the phase of the current will be split and it would be possible to produce a rotary field in this way. Nevertheless, it would not be advisable to employ an armature with different teeth. It is much better to remove from the circuit one part of the winding located in certain notches, for only the teeth magnetized by the current can have any influence on the value of self-induction. If between such two notches there is one slot the winding of which has no current, this part of the armature acts—as regards self-induction—as a winding located in teeth of double thickness.

[1] See The Electrical Engineer, June 3, 1896.

Referring to Fig. 17, if the switch is in the position shown by the dotted lines, the windings drawn dotted are removed from the circuit. Therefore in two quarters of the primary

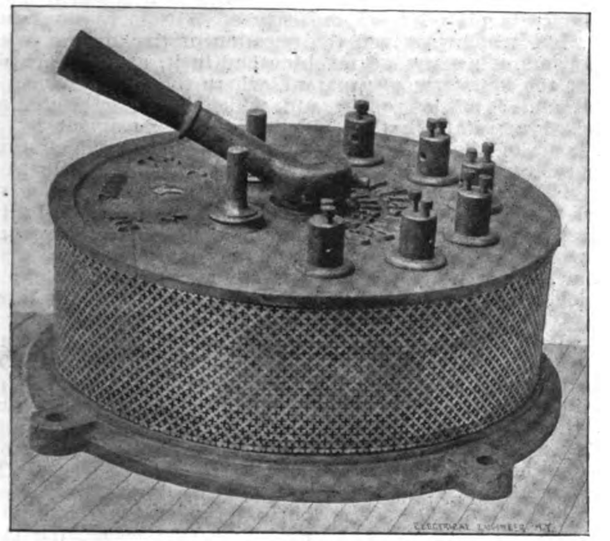


FIG. 16.—STARTING BOX FOR INDUCTION MOTORS.

the winding is located in teeth of double thickness. The motor will start nearly as a diphase motor, for the phase of the main current will be split into two different phases in both windings. At full speed the switch is thrown to the other position, and current flows through every notch. In this way we change during the starting the number of teeth which influence the

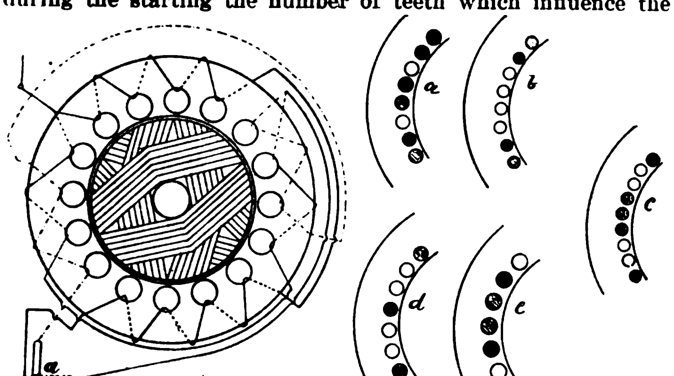


FIG. 17.—KANDO STARTING DEVICE FOR INDUCTION MOTORS.

self-induction. The figures a to e are different ways of proceeding; the windings in the black or in the shaded holes can be removed from the circuit.

An alternating fan motor starts in the way just described. A special small switch permits the change of connections at full speed.

POLYPHASE TRANSMISSION IN BELGIUM.

The Soignies Quarries in Belgium are equipped with an electrical plant which is of interest not only from its extent, but also from the fact of the use of three-phase alternating currents. The territory covered has an extent of 52 hectares and the former method of operation by a central steam plant required a fuel consumption of from 4 to 5 kg. of coal per horse-power hour. The fuel consumption with electrical transmission and distribution is less than 1 kg. Three Cornwall-Galloway boilers are used and a 350 horse-power compound slow-speed engine. Two dynamos are used, one for lighting, furnishing 300 amperes at 125 volts, and a three-phase alternator of the Oerlikon type, furnishing about 200 horse-power for the power work. The power house is centrally located and three lines are run from it, the length of each being 200 m., 310 m. and 700 m., respectively. At present four 24 horse-power motors, one 18 horse-power motor and one 9 horse-power motor, are operated for running sand saws and diamond saws. About 57 horse-power of the alternating current is used for illuminating purposes. The Soignies Quarries are the first industrial institutions in Belgium to use alternating current for power purposes and the results reached seem to fully justify the innovation.

LEGAL NOTES.

THE TROLLEY BASE SUIT.—JUDGE TOWNSEND'S ORDER GREATLY MODIFIED.—TROLLEY BASES MAY BE SOLD AND USED UNDER CERTAIN CONDITIONS.—GENERAL ELECTRIC CO., VS. THE KELSEY CO.—OPINION OF THE U. S. CIRCUIT COURT OF APPEALS.

On July 29 the United States Circuit Court of Appeals, sitting at New York, handed down an opinion in the suit of the General Electric Company against the Kelsey Electric Railway Specialty Company, of New Haven. Its decision, which is final, greatly modifies the stringent prohibition against the manufacture and sale of trolley stands or bases as contained in Judge Townsend's injunction order granted by him in March last against the Kelsey Company. The result is that it is now possible for electric railway companies to replace broken or worn-out trolleys purchased from the General Electric Company, or to replace them entirely by other improved trolley bases purchased in the open market.

Judge Wallace in a dissenting minority opinion, goes even farther and holds that the injunction ought never to have issued and that there ought to be no bar whatever to the free manufacture and sale of trolley bases. In view of the importance of the case we give below both opinions in full:

SHIPMAN, C. J.

The Circuit Court of the United States for the District of Connecticut, after an exhaustive investigation of the validity and alleged infringement of letters patent No. 495,443, dated April 11, 1893, and issued to the administrators of Charles J. Van Depoele, decreed that the Winchester avenue Railroad Company had infringed claims 6, 7, 8, 12, and 16 of the patent. The complainant in the suit was the Thomson-Houston Electric Company, the assignee of the patentees. The combination covered by these claims and now used generally by the electric railroads of the country, consisted "generally in an electric railway having an overhead conductor and a car for said railway provided with a contact device carried by the car so as to form a unitary structure therewith and consisting of a trailing arm, hinged and pivoted to the car so as to bridge the space between it and the conductor and move freely both laterally and vertically, and said arm carrying at its outer end a contact device capable of being pressed upward by a suitable tension device into engagement with the under side of the conductor."

The important and distinctive part of the invention was the trailing arm hinged and pivoted to the car, and moving laterally and vertically, with a contact device at its outer end capable of being pressed upward by a suitable tension device into engagement with the under side of the conductor. The novel element of "the overhead, underrunning, spring pressed, laterally swinging contact arm" was of great utility and has superseded pre-existing attempts at trolley road equipment. The trolley stand, so called, is the means by which the traveling arm is hinged and pivoted to the car with a capacity for lateral and vertical movement, and is pressed upward by some suitable spring. No particular form of a stand was included in the Van Depeole invention, for any one of a number of forms would answer the purpose.

The defendant, the Kelsey Electric Railway Specialty Company, manufactures a particular form of trolley stand, for which letters patent have been issued, which it has advertised for sale, and has also in its advertisements represented itself as a dealer in trolley poles and overhead trolley equipments. Its trolley stand consisted in the main of a base secured to the car roof, a frame revolubly mounted upon the frame so as to receive the end of a trolley arm, and springs by which tension upon the arm is produced. The Thomson-Houston Electric Company having brought suit against the Kelsey Company for infringement of this Van Depeole patent, the Circuit Court for the District of Connecticut granted a motion for an injunction pendente lite against its making or selling any apparatus embodying the subject matter of, or any trolley bases devised or intended to be used in infringement of those claims of said patent which were found to have been infringed in the Winchester case. The present appeal is from this order.

The question, as presented in the affidavit and briefs, relates particularly to the manufacture and sale of trolley stands. As evidence of an intention to infringe, the complainant relied upon the language of the defendants advertisement, which offered for sale the stands and overhead trolley equipment generally.

The defendant admits that he has sold trolley stands directly or indirectly to electric companies which purchased their equipment originally from the .complainant's licensees,

either by way of repair or because the purchasers wanted an improved stand. It denies that it has knowingly sold to an infringer of the patent in suit or to be used for the purpose of infringement. The circuit judge was of opinion that the defendant was selling stands capable of and designed for an unlawful use, and that inasmuch as they are useful only for the purpose of performing functions involved in the operation of the patent, there was a presumption of an intention that these stands should be so used, which was not dispelled by the affidavits.

The question being one of contributory infringement, the appellant urges that there was no sufficient evidence that the defendant had concerted or was concerting, or intended to concert with any person for the infringement of the complainant's patent, and that consequently the injunction order either ought not to have been issued or was too sweeping in its terms.

What contributory infringement is, and why it should be enjoined, was clearly shown in Wallace v. Holmes (9 Blatchf. 65), the earliest case in this country upon the subject, and upon which the subsequent cases if contributory infringement rest. The complainant's patent in that case was for an improved lamp, which consisted of an improved burner or metallic portion and a glass chimney. The defendant made and sold the improved burner, which must be used with a chimney, and in order to make sales, exhibited the burners with chimneys to customers and the circuit judge thought that a concert with others to use the patented article as a whole was a certain inference from the obvious facts in the case, and the efforts of the defendant to solicit sales by showing the operation of the whole patented article.

The willingness of the defendant in this case to aid other persons in any attempts which they may be disposed to make towards infringement, is also apparent. Its trolley stands are designed to be used in the patented system and to be the means of enabling the trailing pole to perform its distinctive and novel part in the combination. It sufficiently appears from the defendant's adverstisements and affidavits, that it was ready to sell to any and all purchasers, irrespective of their character as infringers. A proposed concert of action with infringers, if they presented themselves, is fairly to be inferred from the obvious facts of the case, and an injunction order is the proper remedy against wrongful acts which are proposed or are justly to be anticipated.

But the defendant says also, that the order which was granted, is capable of too sweeping an interpretation, because it has a right to supply purchasers who have acquired the right to use the patented combination, with its trolley stands, either by way of repair, or because the stands which were furnished to them were not adapted to the needs of the cars upon which they were placed, and it invokes the principle which was stated in Chaffee v. Boston Belting Company, 22 How. 217, as follows: "If a person legally acquires a title to that which is the subject of letters patent, he may continue to use it until it is worn out, or he may repair it or improve upon it, as he pleases, in the same manner as if dealing with property of any other kind." The complainant, which is utilizing its patent rights by the manufacture and sale of trolley railroad equipments, and desires to compel purchasers to continue to supply themselves with its form of stands, replies that the defendant's sales are not for the purpose of repair, but are for the reconstruction of the patented combination; and that a reconstruction of a destroyed or worn out combination is an infringement. This proposition is true, and examples of the cases to which it is applicable are found in Cotton Tie Compnay v. Simmons, 106 U. S., 89, and Davis Electrical Works v. Edison Electric Light Company, 60 Fed. Rep. 276. In the Cotton Tie case, the continued use of patented ties, which consist of a band and buckle, was purposely destroyed by the purchaser, by cutting the band after he had received the bale around which the tie was placed, and the parts were sold as waste material. A new purchaser bought the several parts, mended the bands, replaced the buckles, sold them to be used as ties, and was held to be an infringer.

In the Edison case, the reconstruction was equally extensive; the infringer made a hole in the bulb of an Edison incondescent electric lamp, in which the carbon filament had been worn out, put in a new filament having its ends cemented in platinum sleeves, fused a tube of glass into the open end of the bulb, exhausted the air and sealed the bulb. Inasmuch as "the filament duly charged is the light giving thing," the work of the infringer was the manufacture of a new lamp.

The complainant, recognizing that the facts in these cases are not analogous to those in the record now before us, urges that in order to constitute reconstruction of a patented device it is not necessary that the structure should have been destroyed intentionally, or that the vital and peculiar element of the invention should have been worn out by use, but that the substitution of an important member of a patented combination, which was intended to be permanent, in place of the corresponding member which had been accidentally broken or had been worn out, is reconstruction, and that there is a recognized distinction between such a substitution and the replacing of fragile members whose life is necessarily short.

Reliance is placed upon the case of Wilson v. Simpson, 9 How. 108, which involved the question of the interest which the owners of a patented machine had in it, after the expiration of the first term of a patent, where there had been a renewal and extension of it, and which has been sometimes supposed to establish the rule that the replacement by the purchaser of the parts of a patented machine which must, from their nature, be temporary, is permissible while in no event is the replacement permissible of a part which it was hoped would be permanent. The case related to the right of a purchaser of a Woodworth planing machine to replace cutters which ordinarily had a life of only sixty or ninety days, and, as a necessity, the opinion dwells upon that fact, but the decision did not make it a sine qua non, and did not intend to say that temporary cutters can be replaced, and that an element intended to be permanent, but accidentally broken in thirty days after it was purchased, cannot be replaced. The distinction which the court was endeavoring to point out and which it thought was well illustrated in the Woodworth planer, was the difference between the repair or replacement of a single element of a combination and the manufacture of a new machine in place of one which had become useless. The court says: "We admit, for such is the rule in Wilson v. Rousseau, 4 Howard, that when the material of the combination ceases to exist, in whatever way that may occur, the right to renew it depends upon the right to make the invention. If the right to make does not exist, there is no right to rebuild the combination.

"But it does not follow, when one of the elements of the combination has become so much worn as to be inoperative, or has been broken, that the machine no longer exists, for restoration to its original use, by the owner who has bought its use. When the wearing or injury is partial, then repair is restoration, and not reconstruction.

"Illustrations of this will occur to any one, from the frequent repairs of many machines for agricultural purposes. Also from the repair and replacement of broken or worn out parts of larger and more complex combinations for manufactures. In either case, repairing partial injuries, whether they occur from accident or from wear and tear, is only refitting a machine for use. And it is no more than that, though it shall be a replacement of an essential part of a combination. It is the use of the whole of that which a purchaser buys, when the patentee sells to him a machine; and when he repairs the damages which may be done to it, it is no more than the exercise of that right of care which every one may use to give duration to that which he owns, or has a right to use as a whole."

This distinction is both natural and founded upon right reason and gives to the patentee all the benefits to which he is entitled by the grant of the patent. While it is not intended that a trolley stand should be broken, or should lose its useful capacity, either calamity may befall it, and the right to replace the injured part by a new stand from any person who can supply the article, should be conceded by the owners of the patent.

It is not intended to permit the unauthorized substitution of the vital and distinctively new part of an invention in place of one worn out by use, as the substitution of a new filament in an Edison incandescent lamp, or the substitution of a new for an old burner in the Wallace case (supra), but the trolley stand is not the vital element of the invention, though a portion of it is an element of the combination; it is the means, and in most cases the non-patented means, for there are numerous forms of these bases by which the pole is permitted to perform its functions.

The defendant also says that in order to obtain the use of an improved trolley stand, purchasers from the complainant are sometimes willing to discard its stands and substitute another form which has its own advantages. For example, the trolley stand which is sold by the defendant, is said to be less elevated above the top of the car than the stand of the complainant, and, therefore, it is said that the Norwalk Street Railway Company found it necessary to change the stands which were furnished by the complainants, because of the low bridges constructed by a steam railroad company over the tracks of the street electric road. A refusal to permit such a substitution is equivalent to a declaration that the Street Railway Company cannot be permitted to improve its stands, except by the consent of the complainant. If a purchaser of the complainant chooses, the day after his purchase, to substitute a stand which is better made and better adapted to his peculiar needs, he has the right to do so. But it will be urged that such a permission opens the door to infringement and permits a spoliation of the conceded rights of the com-

plainant. It does throw upon the defendant the duty of careful investigation into the objects of the purchasers of its stands and of an abandonment of indifference as to whether they are seeking to trench upon the rights of the owners of the patent or else a liability to suffer the consequences of a violation of the injunction order.

The order is directed to be modified, without costs of this Court by adding the words: It is not intended to enjoin the defendant against the sale of trolley stands by way of replacement of broken stands or stands worn by use, or of substitution for trolley stands previously sold by the complainant to purchasers from it, but this permission does not give authority to reconstruct or rebuild a combination which has been sold by the complainant.

Mr. Frederic H. Betts, for the complainant. Mr. Edward H. Rogers, for the defendant.

The following is the opinion of Judge Wallace:

WALLACE, C. J.

This case presents in my view an utterly unwarranted attempt on the part of the complainant to enlarge the monopoly which it had acquired as the owner of the patents in suit and to dominate exclusively the manufacture and sale of articles which its patents do not cover and which others have a legal and moral right to make and sell. The preliminary injunction by which the defendants are restrained from making or vending their trolley stands was granted without a particle of evidence that they had ever infringed any of the claims of the complainant's patents, and, as I think, without the slightest evidence that they threaten to do so. They are as much entitled to make and sell their trolley stands as they are to make and sell the rails, the poles, the wires, the screws, the paint or any other article which may be required for use by those who own and operate electric railways in which the improvements covered by the patents of the complainant are utilized. The country is crowded with electric railways which utilize these improvements, but the improvements do not consist in the trolley stand; they consist in various combinations of parts of which a trolley stand in some form is one. These railways are generally owned and operated by corporations, a great number of which buy their outfit from the complainant and thereby acquire the right to use the patented combinations during the life of the organized parts. Concededly they have a right to repair their trolley stands, to substitute new ones for those old or worn out, or to substitute a better and improved kind for those originally bought of the complainant. The defendants have an equal right to make and sell the stands to such owners for that purpose.

The injunction was granted upon the theory that a case of contributory infringement had been shown. The only evidence of contributory infringement consists in the fact that the defendants are making, advertising and selling their trolley stands to the public. That they are concerting with infringers with a view to assist them in appropriating without compensation the inventions patented by the complainant there is not a particle of evidence. Being entitled to sell their article they are under no obligation before selling it to inquire whether the purchaser intends to make an illegal use of it. Privity with a wrong-doer is not to be inferred from the exercise of a legal right. The man who sells a gun or a knife would be guilty of an impertinence if he should inquire of the purchaser whether he intends to use it legitimately, and is under no duty to do so. The same rule applies to one who makes or sells an article which is not patented, but which may be used by the purchaser to work an infringement of a patent if he so chooses. One who assists another to infringe a patent is of course a tort-feaser, and whether he is called a contributory infringer, or merely an infringer, is only a matter of nomenclature. But he does not assist or concert with another to infringe merely because he sells him an article which may be used to effect an infringement. In other words, participation in a wrong is not established by doing a lawful act without evidence of an unlawful intention.

I think the order granting the preliminary injunction should be reversed.

A RECEIVER FOR THE U. S. ELECTRIC COMPANY OF BALTIMORE.

ON July 14 application was made for an accounting and for the appointing of a receiver for the United States Electric Power and Light Company, of Baltimore. The petition is directed against the Brush Electric Company and sixteen others, comprising the stockholders of the United States Company. The question is raised that the charter of the United States Company is ineffective because the law does not allow the chartering of an electric company in Baltimore, save for telegraph or telephone purposes. Other electric companies, it is claimed, have amendments to the charters granted by special act of Legislature.

The petitioner charges that the United States Company was formerly operated at a profit, but under the control of the Brush Company, and since last fall has come to be operated at a loss, as the absorbing company took all the profitable contracts to itself. On account of the ineffectiveness of the charter, it is claimed that the stockholders are simply copartners, and for that reason could be made individually liable for the debts of the company. For fear outside creditors would step in and compel the stockholders to pay the deficiency in receipts of the company the receiver is asked.

INJUNCTION AGAINST THE CHICAGO GENEREL ELECTRIC RAILWAY COMPANY DISSOLVED.

Judge Neely last week dissolved the injunction recently obtained by Charles Austin Bates against the Chicago General Electric Railway Company.

Some months ago Bates filed a bill claiming the ownership of $2,000,000 of stock and alleging that he had given it to Pres. Clark escrow. Clark, he said, wanted it simply to make it appear that one man owned a controlling interest in the stock of the company, which would the more readily induce purchasers to invest. The court held that Bates had no valid claim to the $2,000,000 worth of General Electric stock, which he said President Clark was illegally withholding from him.

WESTINGHOUSE AIR BRAKE CO. SUES H. S. PARK ON HIS ELECTRO MAGNETIC CAR BRAKE.

The Westinghouse Air-Brake Company has filed a bill in the United States Court charging Harvey S. Park with wrongfully withholding three patents for improvements on Park's electromagnetic car brake. The company asserts that the purchase of the patents included the subsequent improvements which Park now seems to use for the benefit of himself and A. N. Loeb.

IN conversation with Mr. Louis B. Marks, of the Electric Arc Light Company, who first delivered his lecture on the theory of the inclosed arc at the World's Fair Electrical Congress, in 1895, we learn that many of those who at that time pooh-poohed the practicability of his scheme now admit their error.

Mr. Marks states that he has succeeded in interesting the proper backing, which now represents a capital of $2,000,000, with offers of $7,000,000 to $8,000,000 more when needed. He intends to invoke the full protection of the law for his patents. The long-hour lamp has evidently come to stay, judging by the preference it is receiving in all large orders now being placed.

REPORTS OF COMPANIES.

THE NEW YORK EDISON CO.

We give below the New York Edison Illuminating Company's earnings for June:

	1896.	1895.	Iucrease.
Gross	$ 159,068.02	$ 147,637.40	$11,430.62
Net	67,412.39	72,273.72	5,861.33 dec.
Gross, 6 months ..	$1,105,904.64	$1,015,948.19	$89,956.45
Net, 6 months	544,532.99	491,002.32	53,530.67

EDUCATIONAL.

MECHANIC ARTS AT THE UNIVERSITY OF NEBRASKA.

The University of Nebraska, recognizing the need of secondary technical instruction in that State, has established a School of Mechanical Arts, with the object of giving an impetus to industrial pursuits in Nebraska. Among the faculty we note the name of Professor R. B. Owens, E. E., professor of electrical engineering. This school is intended for those young men who expect to enter some one of the mechanical trades, and who desire a scientific basis for their work. All the scientific and technical instruction is planned to be of practical value in any line of mechanical work that may be taken up. The school year will coincide with the university year, beginning Sept. 15, and closing June 10.

INTERNATIONAL TELEGRAPHIC CONFERENCE.

The conference at Buda-Pesth was opened by a speech from the Minister of Commerce, His Excellency, Ernst Dániel, who presided. Representatives from Chili, San Salvador, and Venezuela, which countries have hitherto stood outside the International Convention, were present, in addition to the accredited representatives of the States subscribing to the convention, and the principal cable and telegraph companies.

SOCIETY AND CLUB NOTES.

MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

The next meeting of the Association of Edison Illuminating Companies will be held on August 11, 12 and 13, at Manhattan Beach, Brooklyn. The Oriental Hotel has been selected as the headquarters of the convention during its Brooklyn session, although the Manhattan Beach Hotel is also available, and within easy walking distance.

The first two days of the convention will be devoted to the reading and discussion of papers, and on the third day the General Electric Company invite the delegates to Schenectady to inspect their works and will return the party to New York on the same day.

VERBAND DEUTSCHER ELEKTROTECHNIKER.

The fourth annual meeting of this society of German electrical engineers was held at Berlin recently, and was, according to the "Elektrotechnische Zeitschrift," a great success. Among the guests at the grand dinner was Li Hung Chang, the viceroy of China. The annual report of the Verband shows an increase in the membership of 102, bringing the total up to 1,645. The finances are in a satisfactory condition, and in the technical department several successes have been obtained. The Verband has been consulted by the Imperial Government with regard to the proposed law relating to the standardizing of electricity meters. Several municipalities have also consulted the Verband in electrical matters. The committee on low-pressure wiring rules reports the completion of the same, and has now been charged with the drawing up of similar rules relating to high-pressure installations. The $75 prize offered by the Verband for the best design of an un-interchangeable fuse was won by Mr. A. Rittershaussen, of Amsterdam. The incandescent lamp question was also under discussion at the Berlin meeting, and a committee consisting of manufacturers, supply station engineers and others, has been appointed to investigate the matter. The election of officers for the ensuing year resulted as follows: President, Herr Stübben, of Cologne; members of council, Herren Budde, Slaby, Naglo, Jordan, of Bremen, and Jordan, of Berlin. Eisenach has been selected for next year's meeting.

ANNUAL CONVENTION OF THE NEW JERSEY STATE DENTAL ASSOCIATION.

ELECTRICITY was very much in evidence in the papers, clinics, and exhibits at the twenty-sixth annual convention at Asbury Park, on July 29-31, of the New Jersey State Dental Association. For a scientific body, this association has a great deal of vigor and enterprise, and at all their meetings the pervading idea seems to be that it will not be long before electrical developments dominate practically the whole field of both diagnostic and operative work in dentistry. This is evidenced in the titles of many of the papers at Asbury Park.

It will be remembered that at the last convention of the association at the same place, quite a sensation was created by Dr. Gillett's paper on "Cataphoresis in the Obtunding of Sensitive Dentine." The principle of the electrical anæsthetizing of the tooth, so as to enable dental operations to be carried out painlessly had long been discussed, but the time occupied in creating the anæsthesia was so long as to be virtually prohibitive. A patient might sit in the chair half an hour, and still not be sure that his tooth was so obtunded that it could be operated upon without pain. The loss of time was serious, the nerves of the patient were disorganized, and not improbably those of the operator also. Dr. Gillette showed that the cataphoric method could be brought down to an operative duration of, on the average, seven or eight minutes. This meant that really painless dentistry was at last within reach, and further investigations in cataphoresis were actively pushed.

This activity has borne somewhat remarkable fruit. Foremost among those who have taken up the subject is Dr. G. Carleton Brown, the results of whose work may be said to have formed the principal feature of this year's convention. Cocaine, which is the standard drug used by dentists for anæsthetizing, is a non-conductor, and to be effective in cataphoresis it had to be blended with an electrolyte. Upon the effectiveness of this combination hung the whole time question of anæsthetic operations. Dr. Brown has discovered that by making a 15 per cent. solution of hydrochloride of cocaine and electrozone, and saturating the electrode cotton with it, perfect anæsthesia can be secured within a minute and a half. A singular point in the production of the obtunder is that after the component parts are placed in the graduated tube, even in carefully gauged proportions, there is no certainty that the product will come out all right. It should have a yellowish precipitate; if the color is white, the product is of no use.

In view of this supreme interest in cataphoresis in the world of dentistry, it is but natural that a leading feature of the electro-dental exhibits is the instrument with which cataphoric work is to be performed. For this instrument no adequate name has yet been originated, and as a makeshift the term volt selector is being used. The Edison Manufacturing Company showed a "fractional volt selector and regulator for cataphoresis," which they claim meets the demand of the dentist for a device that shall actually regulate both the voltage and the amperage used by the operator, when applying either the battery of the street current, for cataphoresis, both for obtunding and bleaching purposes. Their instrument runs up to 100 volts, and the regulator will graduate from 20 volts by one-hundredths of a volt, which gives a perfectly even regulation, and obviates the possibility of unpleasant shock. This question of shock is the bugbear of all the instrument makers. The Edison Manufacturing Company's instrument is provided with a Kennelly volt-milli-ammeter, reading from 0 to 15 milli-amperes, and 0 to 150 volts. By turning a switch to the right, the volt meter is thrown into the circuit, and on moving it to the left the milli-ammeter is brought into service, so that the operator can ascertain at any instant the exact current and voltage he is using. The instrument is equipped with a graduated scale along which moves a pointer for indicating the amount of resistance employed at any time. It can be used equally well for battery and for electric light current.

Another new dental apparatus for cataphoric treatment exhibited by Waite & Bartlett, was the Van Woert rheostat, made after suggestions by Dr. Van Woert, who pins his faith on the intelligent and successful use of cataphoresis to a reliable battery, the cells of which can be thrown on, one or more at a time, in order that the result may be accomplished with as low a voltage as possible. Dr. Van Woert may be looked upon as the apostle of the homeopathic dosage of electricity. His argument that it is of no use to take an electrical sledge hammer when a tack hammer will do is unanswerable. In this instrument a reliable rheostat controls the current evenly and smoothly, so that the patient is distressed by no sudden shocks or jumps. One of the important features of the instrument is a milli-ampere-meter, which is graduated to indicate fifths or tenths of a milli-ampere. The amount of current actually used for ordinary operations rarely exceeds from three-fifths to one milli-ampere. In the Van Woert apparatus, on the contrary, all parts are contained in one small, portable case, to which they are permanently fixed. This apparatus is for dental cataphoresis only.

The very latest candidate for current controlling honors as applied to cataphoresis is the instrument shown for the first time in public in the exhibit of the S. S. White Dental Manufacturing Company. This is one of the most beautiful instruments for surgical and dental work that has ever been constructed. In it the use of the Carpenter enamel rheostat is admirably combined with that of the Weston milli-ammeter, and the result is an appliance which can be used either with battery or street circuit, and which appears to meet all the requirements of cataphoric work.

A very complete electrical dental outfit was also shown by the S. S. White Dental Company. The motor is enclosed in a glass vase to protect it from dust. It has an extra pair of brushes, and collecting rings for use with a transformer for operating the electric mallet, hot-air syringe, etc. The entire control of the running of the engine with this apparatus is in the treadle, which starts, stops, or reverses according to the direction and degree of foot pressure exerted.

The Wheeler fractional volt-selector was also shown at the exhibit of the Electrotherapeutic Company.

The X-ray naturally found an important place in the list of papers. Dr. Houston's paper on this subject, as well as that of Dr. Van Woert, was supplemented by the taking of radiographs by the static machine. Dentists recognize that the X-ray is already invaluable to them for both diagnostic and operative purposes. One picture showed a darkening in the bottom of a tooth the trouble of which it had been impossible to diagnose by ordinary methods. Another showed how the position of children's teeth within the gum can be ascertained, and thus many incipient troubles can be detected and remedied in good time. Dentists are on the lookout for an X-ray outfit of simple design that can be used in their offices, and are already wondering how they have been able to do so long without what now appears an indispensable adjunct to their equipment. In practice, the first thing a dentist will do with a new patient will be to make an X-ray picture of his mouth and jaw. Not only will all irregularities of formation be at once made apparent, but also the metallic filling in every tooth that has been already stopped.

After dwelling on the immense advantage of the new photography to dentistry, Dr. Van Woert proceeded to show the improvements that had been made in electrical dental supplies during the past twelve months. He said that the use of electrolysis for the treatment of abscesses, and certain diseases of the tooth was rapidly extending, and that the electric furnace had become standard in dental laboratories. In the glazing of the teeth and the baking of the investment or mold it saved all cracking and distortion, and the certainty of its results was a pleasant change to men who had had a long experience of the disappointment and vexation of the old dental furnaces.

Interesting additions to the records of new work in the bleaching of teeth by cataphoresis were given by Dr. C. A. Meeker. Dr. Meeker finds the best results with pyrozone, of which he uses a 25 per cent. aqueous solution for cataphoric work. When using hot or dry air, he employs a 75 per cent. ethereal solution. In this way badly discolored teeth can be effectively bleached in 25 to 30 minutes. Beyond these applications of electricity, the extirpation of nerve pulp, extraction, implantation and many other dental operations, as well as new special uses for different kinds of current, came up for discussion.

PERSONAL.

MR. T. C. MARTIN is now en route for New York, having left Southampton August 1, on the American liner "St. Louis."

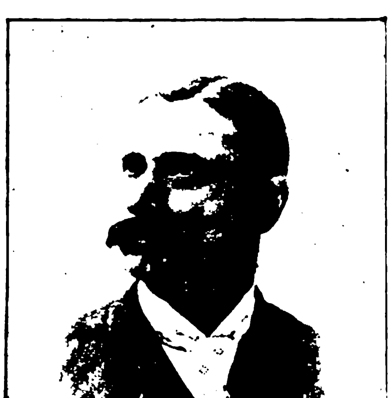
MR. THOMAS G. GRIER, formerly with the Bryant Electric Company, from which he resigned on June 1, has accepted a position with the Western Electric Company, and is now installed in the supply department of that concern.

MR. NIKOLA TESLA has just visited Niagara, where he inspected the great power house, in company with a party consisting of Mr. E. D. Adams, Mr. W. B. Rankine, Mr. Theo. N. Ely, chief of motive power of the Pennsylvania Railroad, and Chief Engineer Geo. W. Melville, U. S. N. This was Mr. Tesla's first visit to Niagara since the great work there was begun.

MR. THOS. J. FAY has been appointed general manager of the C. & C. Electric Company, of New York. Mr. Fay has been associated with the company for a number of years, both in a practical and a business capacity, and his extensive experience in the electrical business undoubtedly qualifies him to take entire charge of the large and growing business of the C. & C. Company.

OBITUARY.

EDWARD A. ECKERT, whose sudden death on July 26 was mentioned in these columns last week, was prominently identified with the invention of important telephonic apparatus. To-day there are few exchanges licensed by the American Bell Telephone Company which do not contain his inventions.



Edward A. Eckert.

He was co-patentee with J. O. Shiras, of the multiple switchboard, and it was under his direction that the first multiple switchboard ever operated was put into service. This was in the Covington (Ky.) exchange of the Bell Telephone Co., of Cincinnati, in 1881.

The monitor desk, with which all large Bell exchanges are equipped, is another of his inventions. By means of this device the manager of the exchange is connected with the receiver and transmitter of each operator and can watch the service without the knowledge of the operator. The patent covering this, as well as the switchboard, were acquired by the American Bell Telephone Company, through its sale to the Western Electric Company, some years ago.

It will be readily seen that Mr. Eckert's inventions are of great importance in the operation of telephone exchanges. First, he improved the switchboard, thus permitting of rapid and reliable service, and then he invented apparatus which brought the discipline of the operating force to the highest standard, and to these two inventions much of the high grade service of to-day may be attributed.

Mr. Eckert was born in 1841, at Wooster, O., and served through the late war in the Military Telegraph Corps.

JOHN J. HOGAN, the inventor of the Hogan boiler, died in Middletown, N. Y., last week, of Bright's disease. He was born in Ireland and was educated in Dublin and Belgium. His mechanical genius led Sir William Fairchild to apprentice him to the Reading Iron Works, near London, paying a fee of £300 therefor. He lived for a time in New York and St. Louis before building the boiler works in Middletown.

NEWS AND NOTES.

FIFTIETH ANNIVERSARY OF THE "SCIENTIFIC AMERICAN."

We congratulate our esteemed contemporary, the "Scientific American," which has just signalized its 50th anniversary by the publication of a very handsome 72-page special number, which consists of a review of the development of science and the industrial arts in the United States during the past fifty years. It was an ambitious undertaking, and the work has been well done. The many articles are thoroughly technical, and they are written in a racy and popular style, which makes the whole volume—it is nothing less, being equal to a book of 442 ordinary pages—thoroughly readable. It is inclosed for preservation in a handsome cover, and is sold at the price of 10 cents.

THE MESSAGE AROUND THE WORLD.

The Western Union Telegraph Company and the Postal Telegraph Cable Company, and the Commercial Cable Co. have filed their official reports of the transmission of the historic message of Dr. Chauncey M. Depew around the world from the National Electrical Exposition on May 10. These reports, together with the original messages in the handwriting of Dr. Depew and Edward D. Adams, will be filed at the Smithsonian Institute, in Washington, together with all of the telegraphic instruments used upon that occasion. The transcription of the messages by Thomas A. Edison, acting as the receiving operator, will also be placed in the institution.

DISTURBANCE OF TELEGRAPH AND TELEPHONE CIRCUITS BY LIGHT AND POWER CURRENT.

Some interesting statistics with regard to disturbances of telegraph and telephone circuits by lighting and power currents have been compiled by the German Imperial Postoffice, and were communicated to the "Elektrotechnischer Verein" of Berlin by Dr. Strecker, a little time ago. The statistics cover the period 1891—1896, and give 76 cases of damage to circuits and apparatus. In 1891 there were five cases, in 1892 four cases, in 1893 two cases, in 1894 fifteen cases, in 1895 thirty-one cases, and in 1896, for the first four months, nineteen cases. The increase in the number of disturbances is explained by the increase of electric tramways. In almost all cases it was telephone circuits that suffered, and only two cases of damage to telegraph lines are reported. In 61 cases electric railways caused the disturbance, and in 15 cases electric lighting plants. In 59 cases the safety devices, such as wooden strips, guard wires, etc., failed to act. In 40 of the 76 cases the telephone or telegraph wire broke, and had been in contact with the live circuit. Many disturbances were caused during the stringing of the telegraph or telephone wire, and also by broken guard wires themselves. The damage caused, however, was mostly small, on an average of about $3.50. There were, however, two fires in 1894 at Dortmund and Barmen, and the damage amounted to $1,350 and $7,750. To protect instruments from currents of too high pressure the German postoffice puts fuses into the circuits. These fuses consist of a wire 0.07 mm. in diameter, and made of a non-oxidizable alloy. They are inclosed in glass tubes 5 cm. to 6 cm. long, sealed up at both ends, and fitted with metal contact pieces. In this way the formation of an arc at 500 volts pressure is avoided. The fusing current of the wire is 0.8 ampere. The whole fuse is kept in position between contact springs, and is easily interchangeable. Another type of fuse used by the Imperial postoffice consists of a porcelain block, about 5 cm. high, the fuse wire running through a hole across the block. Both types have given great satisfaction.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES—III.

BY J. A. FLEMING, M. A., D. SC., F. R. S., M. R. I.

We carried on a long struggle with bismuth in the endeavor to unravel some of the electrical peculiarities of that metal at low temperatures. Chemists are aware of the extreme difficulty of preparing bismuth in a state of perfect chemical purity by purely chemical means. From several different sources we procured bismuth which had been carefully prepared by the reduction of the oxychloride, or nitrate, after careful reprecipitations. This bismuth was then pressed into wire, and its resistance curves taken down to the lowest attainable temperatures. We found some very extraordinary results. Although sensibly agreeing in resistivity at ordinary temperatures, in two cases the resistance curves had a minimum point, and after reaching this at about —80 deg. tended upward again, showing that the resistance was increasing as the metal was further cooled. These curves could be repeated as often as necessary with these samples. Another specimen gave a curve with a double bend (see Fig. 8). These results convinced us

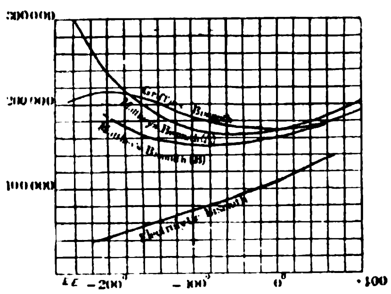


FIG. 8.

that it would be necessary to prepare bismuth electrolytically, and with the assistance of Messrs. Hartmann and Braun, of Frankfort, who have made a special study of the preparation of electrolytic bismuth, we were provided with a quantity of metal, which examination showed to be chemically pure. On taking the resistance curve of a sample of the electrolytic bismuth when pressed into uniform wire under great pressure, we found that its behavior was perfectly normal, and that the resistance line tended downward, as in the case of all other pure metals, to the absolute zero. Also we found that the specific resistance of this last was very much less than that of the chemically-prepared samples, and less even than that employed by Matthiessen. Hence, pure bismuth is no exception to the law enunciated above. Bismuth is characterized especially by many peculiarities. It has been known for some time that the resistance of a bismuth wire is increased when it is placed in a magnetic field so that the lines of the field are perpendicular to the direction of the current flow. This is easily shown by means of one of Hartmann and Braun's spirals, manufactured now purposely for measuring magnetic fields.

We have, however, discovered that if bismuth is cooled to the temperature of liquid air, the effect of any given magnetic field in changing its resistance is increased many times. Thus, for example, a certain bismuth wire we used had a resistance of 1.690 ohms at 20 deg. C. Placed in a magnetic field of strength

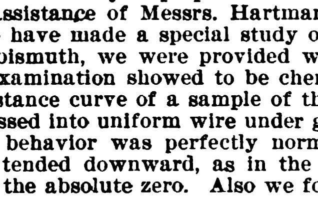


FIG. 9.

2,750 C. G. S. units, its resistance was increased to 1.792 ohms, or by 6 per cent. The wire was then cooled in liquid air, and its resistance lowered to 0.572 ohm. On putting it then into the magnetic field of strength 2,750 C. G. S. units, its resistance became 2.68 ohms. Hence, it had increased 368 per cent. This magnetic field can then actually reverse the effect of the cooling and cause the bismuth, when cooled and magnetized, to have a greater resistance than when at ordinary temperatures and unmagnetized. We are at present engaged in further unraveling the problems presented by this new discovery with regard to bismuth. It is certainly very startling to find that a magnetic field which increases the resistance only 5 per cent. at ordinary temperatures increases it five times at —186 deg. C. It will be seen that this process of taking the resistance of a conductor in liquid air is one which affords us a very critical means of discrimination as to the chemical purity of a metal. It ranks almost with the spectroscope as an analytical method.

Time will only permit one brief reference to the behavior of carbon in regard to electrical conductivity when cooled to low temperatures. We have found that carbon in the form of carbon filaments taken from various incandescent lamps continued to increase in resistance as it was lowered in temperature. The resistivity at various temperatures of the carbon from an Edison-Swan lamp at various temperatures is as follows:

C. G. S. Units.		Temperature.
$3,911 \times 10^3$	at	18° C.
$3,835 \times 10^3$	"	99° C.
3.911×10^3	"	18° .9 C.
$3,953 \times 10^3$	"	1° C.
$4,054 \times 10^3$	"	— 78° C.
$4,079 \times 10^3$	"	—100° C.
$4,180 \times 10^3$	"	—182° C.

These values when represented on a chart give almost a straight line, and show that the resistivity of carbon continually increases as it is cooled, but at a very slow rate. The temperature coefficient is therefore negative, and of about the same absolute magnitude as many alloys of high resistivity. The resistivity of this form of carbon is about three thousand times that of silver. Adamantine carbon taken from a Woodhouse and Rawson lamp had a resistivity 50 per cent. greater.

All the so-called insulators—e. g., glass, gutta percha, ebonite, paraffin—have resistivities enormously greater than that of carbon, but, like it, their resistance increases as the temperature is lowered. For the sake of comparison we have placed upon this chart of lines of metallic resistivity the resistance line of carbon, with ordinates drawn to a scale of one-hundredth part of those of the metals. To properly represent to the full scale the line of carbon, this chart, which is fifteen feet long, would have to be made one-third of a mile long. If we desired to represent on the same scale the resistivity of gutta percha, the length of the chart would have to be billions of miles; in fact, so long that light would take 5,000 years to traverse it from one end to the other. Even then, to represent to the same scale the resistance lines of paraffin and ebonite, it would have to be thirty or forty times longer[1].

We must next pass on to consider some problems in thermo-electricity which have engaged our attention. If we construct a thermo-electric couple of two metals in the form shown in the diagram (see Fig. 9), and connect this with a galvanometer, and if one junction is kept at a constant temperature—say, 0 deg. C.—whilst the other junction is heated or cooled to various temperatures, we shall in general, but not always, find an e. m. f. acting on this circuit when the junctions are at different temperatures. This e. m. f. depends on three things—the nature of the metals, the temperatures of the junctions, and on a certain temperature called the neutral temperature of the metals. An important matter in the experimental theory study of thermo-electric action is to discover the position of these neutral temperatures when different metals are tested with lead as the standard of comparison, and when one junction is kept at 0 deg. C. Elaborate experiments made by Professor Tait many years ago furnished full information on this matter for temperatures lying above 0 deg. C., and we especially desired to extend this knowledge to ranges of temperature between 0 deg. C. and —200 deg. C. Accordingly a number of thermo-electric junctions were prepared of various pure metals and alloys, the comparison metal being always pure lead. These couples were grouped together, and one set of junctions always kept at 0 deg. C. in melting ice. The other sets were cooled to various low temperatures by means of liquid air. The experimental process then consisted in measuring the e. m. f. set up in each length respectively, and at the same instant measuring the temperature of the low-temperature junction.

Two general conclusions are arrived at from a study of the thermo-electric lines as laid down in our chart, Fig. 7. The first of these is that the thermo-electric lines of many metals are by no means straight lines over extreme ranges of temperature. Hence the thermo-electric power is not simply a linear function of the absolute temperature. The second important fact is, that in the thermo-electric lines of certain metals at low temperatures there are sudden changes of direction, which indicate a change in the sign of the Thomson effect in that metal, and probably, therefore, some important molecular change at the corresponding temperature.

[1] The resistivities of platinoid, carbon and gutta percha at 0 deg. C. are nearly in the ratio of the numbers 4×10^4, 4×10^6, and 4×10^{23}.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Currents:

ALTERNATING CURRENTS IN CONDENSER RUSHES.—By Bernard P. Scattergood, M. A., Oxon. Some phenomena observed and explained in detail.—Lond. "Elec. Rev.," July 17, '96.

Central Stations:

CENTRAL STATIO NWORKING.—By W. L. Gethins. The eighteenth of a series of papers on this subject deals with system and forms in central station management.—"Elec. World," July 18, '96.

DETROIT MUNICIPAL LIGHTING PLANT.—General description of plant with an account of the costs of construction and operation.—"Elec. Eng'r.," July 29, '96.

MUNICIPAL CONTROL.—By W. Worth Bean. An account presented to the citizens of St. Joseph, Mich., showing the mistakes of municipal control.—"Elec. Eng'r," July 29, '96.

CENTRAL STATION INSURANCE.—By C. C. Paige. Read before the Northw. Elec. Assoc. Author suggests that underwriter rules should be modified.—"Elec. Eng'r.," July 29, '96.

SELECTION OF A DYNAMO.—By Cecil P. Poole. Author considers insulation, armature windings, commutator, brushes and holders, field magnet, sub-base, bearings and pulley. An outline of the salient points.—"Am. Elec.," July, '96.

Dynamos and Motors:

ON A WINDING FOR MOTOR GENERATORS.—By P. M. Heldt. A method for obtaining alternating current.—"Elec. World," July 18, '96.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST EXHIBITION.—By Alfred O. Dubsky. A description of the Ganz & Co. alternator with a view of elevation and section.—"Elec. Eng'r.," July 22, '96.

SINGLE-PHASE ALTERNATING CURRENT MOTOR.—By Gordon J. Scott. A brief outline of the Scott and Janney motor.—"Elec. Eng'r.," July 22, '96.

DISSIPATION OF ENERGY BY ARMATURE CURRENT.—By Otto T. Bláthy. Author claims to have discovered a loss of energy thus far unobserved, but editorially this is looked upon rather sceptically.—Lond. "Elec.," July 17, '96.

ARMATURES OF MASSIVE IRON IN ROTARY CURRENT MOTORS.—By V. Dolivo-Dobrowolsky. The rotary current motor constructed by the author about 1889, which was of the squirrel cage type, consisted of laminated iron sheets and paper insulated conductors. He has shown lately that a solid iron coil and no paper wrapping around the conductors makes the machine practically of the same efficiency.—"Elektrot. Zeitschr.," July 9, '96.

HOW IS MOTION GIVEN TO THE ARMATURE OF A DIRECT CURRENT MOTOR?—By Townsend Wolcott. A popular description in "Am. Elec.," July, '96.

MODERN COMMUTATOR CONSTRUCTION.—A large number of types described and illustrated in "Am. Elec.," July, '96.

Insolated Plants:

THE POWER PLANT AT THE NEW YORK CUSTOM HOUSE.—Power and lighting is done from the same type of units, at a pressure of 220 volts. Three units are employed. Detailed description of generating plant and distribution system.—"Elec. World," July 18, '96.

Lighting:

USE OF HIGH-VOLTAGE LAMPS.—By W. N. Stewart.—Gives a list of central stations which use the 220 volt lamp, and dwells on the simplicity attached to a high voltage system.—"Elec. World," July 18, '96.

SAHULKA DIRECT-CURRENT EFFECT IN ALTERNATING CURRENT ARC IRON-CARBON.—By Franz Gold. A peculiar effect was studied according to which a strong direct current flows in the direction from iron to carbon electrodes. The author repeated Sahulka's experiments and explains in detail his method of experimenting in "Zeitschr. f. Elektrot.," July 15, '96.

ELECTRIC ARC EFFICIENCY.—By A. Blondel. Paper read at the Congress of the French Asso. for the Adv. of Science. By means of the lumenmeter, careful tests were performed.—"L' Eclairage Elec.," July 4, '96.

Magnetism:

EFFECTS OF HYSTERESIS AND FOUCAULT CURRENT ON POLAR DIAGRAMS.—By F. Bedell and James E. Boyd. Mathematical treatment of certain effects.—"Elec. World," July 18, '96.

Measurements:

INSULATION MEASUREMENTS OF SYSTEMS AT WORK.—By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Methods for determining insulation resistance of continuous current three wire systems, while at work. It is shown how the individual leakage conductances may be approximately determined by varying the working pressure on one side of the system and observing the corresponding variation of potential to ground on the other; also how the resistance in and up to the ground of a grounded conductor under load may be measured from the central station.—"Elec. World," July 25, '96.

THE CAPILLARY ELECTROMETER IN THEORY AND PRACTICE.—By Geo. J. Burch, M. A. Author describes minutely how to make the instrument. He discusses the law of the capillary electrometer, gives full directions for producing photographic records, and concludes by giving some applications of his apparatus.—Lond. "Elec.," July 17, '96.

MEASURING OF SELF-INDUCTION.—By Hugo Andriessen.—Description of a new method for measuring self-induction, where the resistance of the circuit is arranged so as to cancel.—"Elektrot. Zeitschr.," July 9, '96.

Miscellaneous:

LIGHTNING ARRESTERS.—By W. R. Garton. Paper read before the Northw. Elec. Assoc. Same general points regarding lightning arresters and a description of the Garton type.—"Elec. Eng'r.," July 29, '96.

ELECTRICITY IN PAPER MAKING AT NIAGARA FALLS.—By Orrin E. Dunlap. Description of plant with a view of turbine and one generator in the Cliff Company's new power house.—"West. Elec.," July 25, '96.

Railways:

SERIES PARALLEL CONTROLLER.—By Wm. Baxter, Jr. A description with illustrating diagrams of the General Electric controller for four motor equipments.—"Elec. World," July 18, '96.

TESTS OF HEAVY MOTOR CARS.—By H. P. Curtiss and H. O. Pond. Graduating thesis at Cornell University. Some results of tests on four-motor equipments, friction, traction, acceleration curves, distribution between motors.—"Str. R'way Rev.," July 15, '96.

ELECTRICALLY BRAZING RAIL BONDS.—A method of brazing the copper bond directly to the rail by means of electric current. The inventor is D. W. Payne, of Elmira, N. Y.—"Str. R'way Rev.," July 15, '96.

WASHINGTON, ALEXANDRIA AND MOUNT VERNON ELECTRIC RAILWAY.—Description of devices for automatic changing from underground to overhead trolley.—"Str. R'way Rev.," July 15, '96.

Telegraphy:

GOVERNMENT TELEGRAPHY.—By Patrick B. Delany. Abstract of argument before the U. S. Senate Committee; states the advantages of Government Ownership and urges the adoption of more rapid systems.—"Elec. Eng'r.," July 22, '96.

Roentgen Rays:

THE SURVIVING HYPOTHESIS CONCERNING THE X-RAY.—By Dr. Oliver J. Lodge, F. R. S. The article is mainly devoted to a lucid exposition of the meaning and bearing of a marvelous piece of mathematical prediction, due to Helmholtz and dating back to the early part of 1893. Taking for a basis the electromagnetic theory of light, Helmholtz worked out the properties of electromagnetic waves of various lengths, with the result that before even the peculiar properties of Lenard rays were known, Helmholtz accurately described, as regards reflection and refraction, the behavior of the numerous varieties of X-rays.—Lond. "Elec.," July 17; Elec. Engr., Aug. 5, '96.

SOME EXPERIMENTS WITH ROENTGEN RAYS.—By John Burke, M. A. Deals principally with measurements of radiation.—"Lond. Elec.," July 17, '96.

ROENTGEN RADIATIONS.—Some remarks by Sir G. Stokes, according to which this scientist strongly believes in their being transverse vibrations.—Lond. "Elec. Eng'r.," July 17, '96.

Electro-Chemistry:

ELECTRO METALLURGY OF ALUMINUM.—By Dr. J. W. Richards. Author considered electrolysis of aqueous solutions and of fused compounds and finally electrothermal processes. Abstracted from the May issue of the "Journ. of the Frank. Inst.," in Lond. "Elec. Rev.," July 17, '96.

Transformers:

ALTERNATE CURRENT TRANSFORMERS.—By Dr. J. A.

Fleming, F. R. S. Cantor lectures delivered before the Soc. of Arts. The first lecture deals with the action of a transformer. —Lond. "Elec. Eng'r.," July 17, '96. Lond. "Elec. Rev.," July 17, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 28, 896.

Alarms and Signals:—

ELECTRIC RAILWAY SIGNAL. W. Daves, Jersey City, N. J., 564,683. Filed April 22, 1896.
Comprises automatic time circuit-controlling mechanism whereby the motor circuit will be opened or closed after a certain length of time.

SIGNALING APPARATUS. P. Lupke, Trenton, N. J., 564,706. Filed May 9, 1895.
A circuit-closing device adapted to be operated by a pivoted hanger when the latter is struck by a traveling obstruction.

ANNUNCIATOR. C. C. Gould, Buffalo, N. Y., 564,746. Filed Sept. 28, 1891.
Specially adapted for telephone switchboard use.

Secondary Batteries:—

PASTE-CARRYING PLATE FOR ELECTRIC ACCUMULATORS. F. W. Schneider, Triberg, Germany, 564,652. Filed May 2, 1896.
Consists of parallel bars, the sides of which are perpendicular to the faces of the plate and are connected each to the next by bridges.

Distribution:—

ELECTRIC TRANSFORMER. F. L. Sessions, Fort Wayne, Ind., 564,944. Filed Sept. 28, 1895.
Designed for use in triphase or polyphase systems.

Dynamos and Motors:—

ALTERNATING CURRENT GENERATOR. B. G. Lamme, Pittsburg, Pa., 564,702. Filed April 30, 1894.
A multipolar polyphase alternating current generator, a field magnet and an armature having two more poles than said field magnet, and a closed coil carried by said armature.

ALTERNATING CURRENT GENERATOR. B. G. Lamme, Pittsburg, Pa., 564,703. Filed June 30, 1894.
A closed coil radial pole armature having all its poles wound in the same direction, the wire being wound so as to skip alternate poles.

DYNAMO ELECTRIC MACHINE AND ELECTRIC MOTOR. W. B. Elliott and J. W. Eskholme, Westfield, N. J., 564,743. Filed Aug. 26, 1895.
The armature coils are provided with supporting frames, and independent cores that are adapted for insertion in, and removal from, the coils and frames.

Electro Metallurgy:—

PROCESS OF NICKEL PLATING. H. L. Haas, New York, 564,748. Filed Nov. 27, 1895.
Consists in employing, in a neutral solution, a continuous solid anode having a corrugated surface, and then passing an electric current through the anode and solution, balancing the solution of the anode and the deposit at the cathode, whereby the metallic strength of the solution is maintained substantially uniform.

ELECTRIC METAL SEPARATOR. H. H. Whitacre and A. C. Wolfe, Wellsville, O., 564,858. Filed Nov. 8, 1895.
A conducting pipe, a series of magnets radiating from the exterior thereof, and a supporting ring for said magnets, of two series of converging fingers of different lengths, respectively, within the pipe, the fingers of each series being arranged alternately and constituting multiform polar extremities of the magnets.

Lamps and Appurtenances:—

INCANDESCENT ELECTRIC LAMP FITTING. E. F. A. Soleau, Paris, France, 564,723. Filed March 19, 1896.
Means for reducing the size of holder to a minimum for electroller uses.

CUT-OUT FOR ARC LAMPS. A. H. Lucas, Pittsburg, Pa., 564,757. Filed April 4, 1896.
Provides automatically operative means when the lamp is lowered, to close the shunt circuit through the lamp.

ELECTRIC ARC LAMP. W. C. Armstrong, New York, 564,771. Filed Aug. 29, 1895.
Consists of a chimney of reduced diameter located above the works, a cover to inclose the works, fitted to slide up and down along the chimney.

ELECTRIC ARC LAMP. W. C. Armstrong, New York, 564,772. Filed Aug. 29, 1895.
Similar to above.

ELECTRIC ARC LAMP. B. B. Ward, New York, 564,907. Filed Feb. 15, 1893.
Device for protecting the shunt coil of the lamp.

Metal Working:—

ELECTRICAL METAL WORKING APPARATUS. H. Lemp, Lynn, Mass., 564,792. Filed Nov. 25, 1892.
The combination with clamps for the work, of a transformer, and means for freely moving the terminals thereof into and out of electrical circuit with the work.

ELECTRIC METAL SEPARATOR. H. H. Whitacre and A. C. Wolfe, Wellsville, O., 564,859. Filed Nov. 8, 1895.
Similar to above.

Miscellaneous:—

MOTOR VEHICLE. C. H. Barrows, Willimantic, Conn., 564,584. Filed July 6, 1895.
Comprises a rotary twin electric motor mounted on a spindle to have its weight equally distributed on opposite sides thereof, and direct gear connections between the motor-shaft and driving-wheel.

ELECTRICAL PROPULSION OF CANAL BOATS. A. C. Mather, Chicago, Ill., 564,629. Filed Dec. 1, 1893.
A flexible line extending from the trolley to a canal boat, and means for taking up the slack in the line.

ELECTRICAL SOAP. H. E. Rider, New York, 564,717. Filed Oct. 8, 1895.
Inserts a galvanic element in the soap. See page 129.

SECONDARY ELECTRIC CLOCK. J. H. Wilson, Rockwood, Tenn., 564,811. Filed Jan. 9, 1896.
Details of construction.

METHOD OF PURIFYING WATER. G. H. Sellers, Wilmington, Del., 564,940. Filed Sept. 6, 1895.
Consists in agitating therein pieces of another metal with which the iron can form a galvanic couple so as to facilitate the formation of an iron salt, soluble in the water.

Railway Appliances:—

ELECTRIC CAR BRAKE. A. W. Mitchell, Winthrop, Mass., 564,632. Filed Sept. 19, 1895.
Consists of a brake rod, a gear on said rod, a rack bar arranged to move back and forth in suitable guideways and engaging with the gear, and a spring secured to a suitable support bearing on said rack bar.

TROLLEY FINDER. H. Ogborn, Indianapolis, Ind., 564,638. Filed Jan. 13, 1896.
For description see page 122.

TROLLEY. D. Lippy, I. E. Finfrock, G. A. Rhinehart and D. R. Francis, Mansfield O., 564,793. Filed Sept. 24, 1895.
Comprises a frame, a pivoted masthead, a coiled spring, a block connected to said head and with the spring and means for adjusting said block, to change the tension of the spring.

TROLLEY. D. Lippy, I. E. Finfrock, G. A. Rhinehart and D. R. Francis, Mansfield, O., 564,794. Filed Sept. 24, 1895.
Similar to above.

TROLLEY. D. Lippy, I. E. Finfrock, G. A. Rhinehart and D. R. Francis, Mansfield, O., 564,795. Filed Sept. 24, 1895.
Similar to above.

ELECTRIC RACK-LOCOMOTIVE. David L. Barnes, Chicago, Ill., 564,861. Filed March 19, 1896.
A motor having a frame supported by the axle and also having a bearing on the frame of the locomotive and gearing between the armature shaft of the motor and the axle, one of the elements of said gearing being the rack-shaft.

ELECTRIC-MOTOR SUPPORT. Sidney H. Short, Cleveland, O., 564,902. Filed Oct. 3, 1889.
A frame mounted on the axles independently of the yielding support for the car body, said frame having a support at two points upon one axle, and suspended at a single point at its other end, from the other axle.

YIELDING AND SELF-ADJUSTING SUPPORT FOR TROLLEY WHEELS. A. M. Brunswick and G. E. Johnson, Los Angeles, Cal., 564,955. Filed Oct. 7, 1895.
Comprises an inner and an outer frame, a trolley wheel journaled in the inner frame, and suitable means connecting the inner and the outer frames and arranged to allow the inner frame to partially rotate with relation to the outer frame.

Switches, Cut-Outs etc.:—

BACK CONNECTION FOR SWITCHBOARDS. A. J. Wurts, Pittsburg, Pa., 564,679. Filed Nov. 7, 1895.
The combination with a switchboard back terminal stud, of a plurality of separable coupling devices independently clamped thereon, each of said coupling devices having a socket for the reception of the end of the conductor.

ELECTRIC CURRENT REGULATOR AND DISTRIBUTOR. A. H. Washburn, Brockton, Mass., 564,951. Filed May 22, 1896.
A device by which a number of lights in groups or singly and of different colors may be put in or cut of circuit by groups or singly and the amount of current may be varied.

Telephones:—

TELEPHONE SYSTEM. C. C. Gould, Philadelphia, Pa., 564,745. Filed June 5, 1895.
A supporting frame, a switch plunger guided thereon, an electromagnet having an armature, a catch engaging with said plunger, and a locking slide operated by the armature of the electromagnet and interlocking directly with the catch.

ELECTRICITY AT THE VIRGINIUS MINES, COLO.

Our readers may recall the interesting description published by The Electrical Engineer of the electric power transmission installation at the Virginius Mines of the Caroline Mining Company, at Ouray, Colo. This was one of the first power transmission plants installed in this country and its operation since its installation in 1891 has been continuous.

The Virginius Mines are situated near the summit of Mount Sneffles, in a region of perpetual snow, some 12,700 feet above the level of the sea, or 5,000 ft. above the timber line. They consist of some mines rich enough to repay mining under the most adverse circumstances and of others containing a low grade of ore, which could not be mined profitably without cheap power. This power is derived from water of Red Canyon Creek, which is brought through a pipe line 4,000 feet long to Pelton wheels which drive G. E. bipolar dynamos. The transmission line passes first through dense timber, then over rocks and chasms and heavy snowdrifts until it reaches the mine four miles away from the power house. The current is direct and the voltage 800 volts. The motors drive hoists, pumps, blowers, stamping mills, drills and an order has recently been given the General Electric Company, which put in the original plant, for an 800-volt two motor mining locomotive for hauling the silver ore laden wagons in the mine.

Access to the mines in winter is impossible and in summer extremely difficult and before the adoption of electricity the Caroline Mining Company were paying $18 a ton for their fuel, the expense of this item amounting to over $100 a day. The amount of power now used is double that formerly supplied by the superseded steam plant, and the saving probably more than repays the cost of the plant every year.

Trade Notes and Novelties

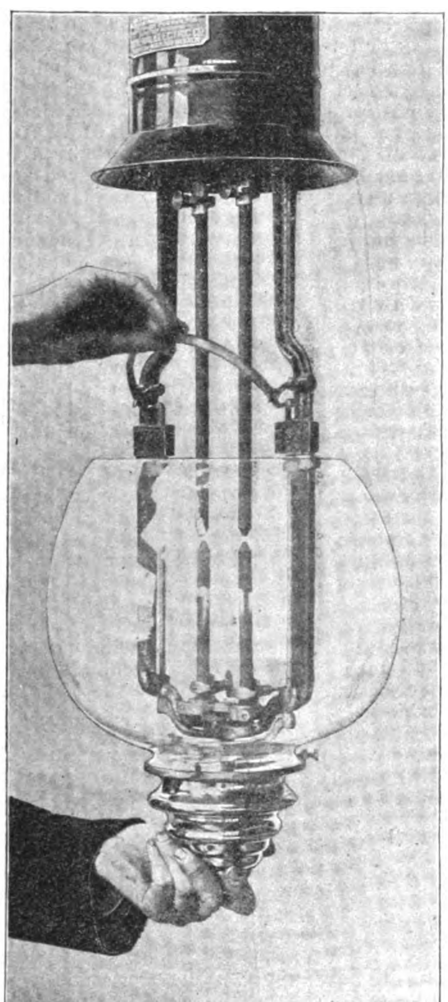
AND MECHANICAL DEPARTMENT.

BIDS WANTED FOR AN ELECTRIC LIGHT PLANT.

The electric light plant at the city of Salisbury, Chariton County, Missouri, was recently burned. At a meeting of the City Council, held July 28, 1896, an order was made and a committee appointed to advertise for bids on a franchise for putting up the electric light plant for the city. In compliance with that order the committee solicits bids of any person, corporation, company or syndicate. All bids or communication should be addressed to chairman of committeee, W. A. Thomas, or Secretary T. F. Trammell.

G. E. GLOBE LOWERING DEVICE.

To satisfy the need of a device for lowering an arc lamp globe in the shortest possible time without danger of breakage the General Electric Company has designed its new globe-lowering apparatus. The holder proper is hung from the vertical rods sliding along the sides of the lower frame. When in normal position these are held from above by a latch positive and certain in action, and locked by the weight of rods and holder. To lower the globe it is first lifted slightly to unlock

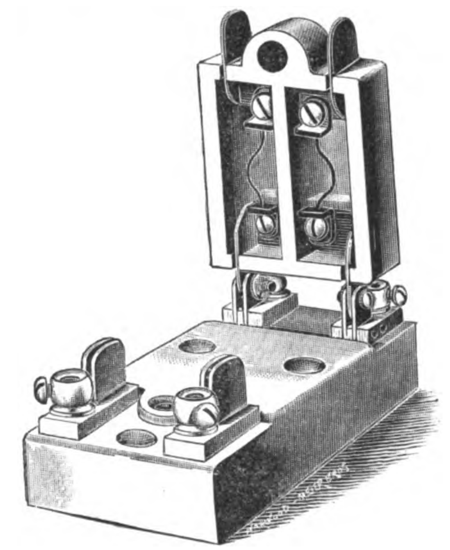


G. E. GLOBE LOWERING DEVICE.

the latch which may then be raised, releasing the rods and permitting the globe to be lowered several inches farther than in the old style lamps. This gives better access for trimming and cleaning. The fact that the globe must be lifted slightly before lowering insures a support from below and prevents its dropping accidentally. Every class of the many forms of arc lamps manufactured by the General Electric Company is now equipped with the new globe-lowering device.

THE FAGAN CUT-OUT.

The Electric Engineering and Supply Company, of Syracuse, are manufacturing a very ingenious device, known as the "Fagan" cut-out. It is a combination of a cut-out and switch. The illustration shows it as a double pole main block with a cover hinge on one end. Fuses are placed in the cover and can be easily replaced and the circuit is always broken when the cover is open. It is designed especially for an entrance switch, and

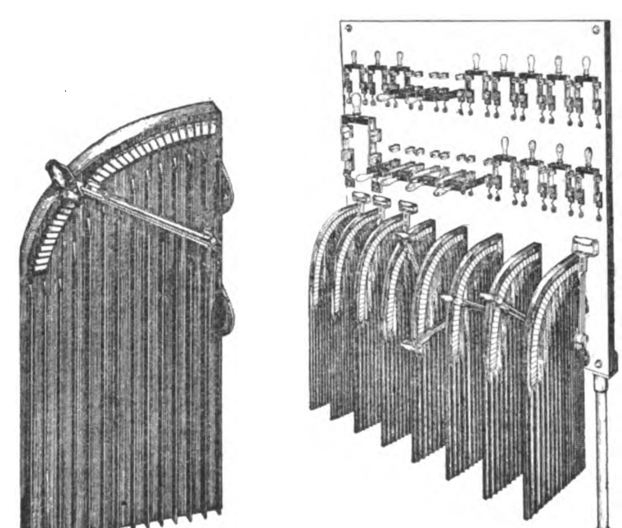


THE FAGAN CUT-OUT BOX.

answers the double purpose of a fuse block and switch. It is designed to be operated with a cord which is fastened in the hole at the lower end of the cover, passing through a hole in the base between the two contact terminals and then running along the channel in the back of the base and hanging down from the ceiling within easy reach of the hand. Or, if desired, it may be operated with a hook fixed on the end of a pole. This device takes very readily with practical men and the company report large sales of it.

IRON CLAD THEATRE DIMMERS.

The Iron Clad Rheostat Company, of Westfield, N. J., are putting upon the market a new line of theatre dimmers, one of which is illustrated in the engraving, Fig. 1. These dimmers are intended to supply the demand for dimmers which have more steps than the standard 21-step dimmer manufactured by



FIGS. 1 AND 2.—IRON CLAD THEATRE DIMMERS.

this company, and they are supplied with handles which move through an arc of 90 degrees, giving their maximum effect with the least possible movement of the handle. Fig. 2 illustrates the manner in which these dimmers are mounted on theatre switchboards.

They are made entirely of cast iron, inside of which, her-

metically embedded and sealed in solid insulating material, are the resistance wires. The iron shell acts as a radiator which quickly dissipates the heat of the coils, and being very compact, these machines are particularly adapted to the limited space in the wings of a theatre. The switch is so designed that where several dimmers are installed any or all of them may be thrown in simultaneously by means of an interlocking arrangement.

It is expected that these dimmers will fill a long-felt want for a low-priced dimmer with a large number of steps. The company is prepared to furnish them with 51 steps in all sizes and in any combinations.

NEW YORK NOTES.

THE WHITLOCK COIL PIPE COMPANY, Elmwood, Conn., are running busy at their Newark factory welding pipes by electricity. Aside from steam use these pipes are largely used in the ice and refrigerating trade.

FRANCIS KEIL & SON, 163d street, New York, manufacturers of builders' and miscellaneous hardware, are also the patentees and makers of the "Reliance" electric door spring opener. Their factory is one of the finest above the Harlem.

USERS OF SILK for insulating wire and for all electrical purposes will find it to their advantage to write for prices and samples to Charles N. Martin, silk manufacturer, 348 Canal street, New York. Mr. Martin carries a large and varieu stock of silk for every requirement in the electrical line.

C. A. ECK, 116 Wooster street, New York, reports large orders on his improved fan motor, which keep his factory busy full time. Mr. Eck contemplates moving shortly into a larger factory out of town, owing to increased business and to secure better facilities, especially for the manufacture of his power motors and ⅛ to 10 horse-power dynamos.

A DISASTROUS fire destroyed the major part of the factory of Messrs. Hamerschlag & Co., Thursday, July 23. We regret to hear of their misfortune, but from information gathered the two energetic members of this firm will have their factory in running order very shortly, turning out motor brushes and other electrical specialties manufactured by them.

THE ENTERPRISE COMPANY, New York, have been running busy night and day since May 1 on fan motors and electrical specialties which they manufacture for the trade only on contract. This firm is doing a prosperous business, due chiefly to the fact that the members of the firm, Messrs. W. B. Elliott, J. W. Eckholm and H. J. Linder, are all practical electricians.

THE C & C ELECTRIC COMPANY, of New York, have instituted a new departure in the manufacture of switchboards and will be glad to hear from electrical engineers and contractors, and furnish them with estimates on all classes of switchboard work. At present they are quite busy on their regular line of dynamos and motors, and with this new department are better equipped than ever to contract for complete installations.

THE LEONARD ENAMEL RHEOSTAT, in which a metal ribbon is attached edgewise by enamel to an iron plate, is proving to be a boon to the electric traveling crane and elevator trade to whom the rheostat problem has always been a most troublesome one. The capacity of this rheostat for absorbing overload currents without visible effect is most surprising to those familiar with the way the old coiled wire rheostats used to perform.

EUGENE MUNSELL & CO., miners and importers of mica, 218 Water street, New York, and 153 Lake street, Chicago, are enjoying an excellent trade in India mica, of which they make a specialty, being direct importers from the mines, and employing a large force in selecting the mica. They are in a position to furnish it cut to size and stamped to any shape or pattern for electrical insulation. They have just issued a neat price list, which is being mailed to the trade, and offer to send samples and quotations to the electrical trade on application.

AMONG the many exhibits which attracted attention in the Edison collection at the National Electrical Exposition was a large and striking copyrighted photograph of Mr. Edison seated outside his office at the Ogden Mines. This has been pronounced one of the finest pictures of the inventor ever taken. In view of the numerous inquiries that have been made as to where copies can be had, it may be stated that the photograph was taken by Kreidler & Crider, Easton, Pa., who will send it direct postpaid to any address on receiving a remittance of $2.

THE BABCOCK AND WILCOX COMPANY announce that they have consolidated their Canadian Sales Department with the General Sales Department at New York, and request that after this date, all correspondence be addressed to the Babcock and Wilcox Company, 29 Cortlandt street New York City. No change will be made in the Manufacturing Department, and all boilers for the Canadian trade will be built at the Belleville shops as heretofore. Mr. W. T. Bonnel, the company's former Canadian agent, has been appointed manager of the Babcock and Wilcox Company's business in the Cincinnati district, with headquarters at 969 Neave building, Cincinnati, O.

MR. CHARLES E. JENKINS, of the Belding Electric Alarm Mail Box Co.,of Chicago, is in the city at present for the purpose of placing the box on the Eastern market. Mr. Jenkins desires to make arrangements with some one well acquainted in the electrical business, and familiar with architects, to represent the Belding Company, and to push the box in this territory. In Chicago the box has had a big success, and as the company has done all its experimenting, it is ready to guarantee a perfect article. The mail box is intended to be put in apartment and office buildings, and gives an alarm as soon as mail is dropped in. It will alarm whenever any outsider tampers with it, and is also equipped with a visitor's call bell. The boxes are finished in thirty different styles, and are extremely handsome in appearance. Any one desirous of adding a specialty to his line should call on Mr. Jenkins, at 247 Canal street, New York, where he has a sample set in working order.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY have remodeled their American telephone switchboard, introducing a number of important improvements, which they claim will make their board the most desirable on the market. They will be pleased to give full particulars on application.

THE SUNBEAM INCANDESCENT LAMP COMPANY, of Chicago, have discontinued manufacturing in their old factory and in a week or ten days will be able to start manufacturing in the new one located at Desplaines, a few miles out of Chicago. The new factory has been fitted up with the very latest modern devices for the manufacture of incandescent lamps.

THE BROWN HOISTING AND CONVEYING MACHINE COMPANY, of Cleveland, O., general Eastern office, Havemeyer Building, New York, have just received an order from Fried. Krupp, at Essen, Germany, for a complete hoisting and conveying plant for their blast furnace at Rheinhausen. This plant consists of three standard Brown overhead bridge tramways, to be operated by electricity, each machine having independent winding drums and electric motors. The Brown Hoisting and Conveying Machine Company are to furnish all the working parts, including the sheaves, engines, motors, hoisting and conveying machines, etc., in fact, everything but the bridges proper, which will be built in Germany, the Brown Company sending a man abroad for that purpose. There will be three Elwell-Parker motors used of about 60 horse-power each. The entire plant is to be in operation during the early part of 1897.

THE BELDING ELECTRIC ALARM MAIL BOX COMPANY, of 1038 Unity Building, Chicago, have just issued a new catalogue of their well-known electric alarm mail boxes. It is very attractive in appearance and is also most descriptive, as it contains 32 pages of cuts and reading matter. It goes very minutely into all details, regarding every style and size of box manufactured by this concern and also gives several cuts and diagrams of the interior and electrical parts in connection with them, so as to enable purchasers who are not technical to easily understand how they are operated. Amongst the many fine half-tone cuts are shown some of the buildings and residences in which they have already been placed. Architects, contractors, and others contemplating the erection of office or other buildings will find this catalogue very useful, as a good style of mail box forms a most important adjunct to every up-to-date building and dwelling.

NEW ENGLAND NOTES.

THE ELECTRIC STORAGE BATTERY COMPANY have removed their Boston office to 92 State street. Mr. Arthur E. Childs, their New England manager, will be glad to welcome his friends at the new quarters.

THE CROWN WOVEN WIRE BRUSH COMPANY, of Salem, Mass., are now supplying their customers with phosphor-bronze and brass brushes at the same price as copper brushes. This company have built up a large trade in their woven wire brushes and are now supplying nearly all the large builders of electrical machinery.

Their brushes are acknowledged as standard in all parts of the United States, Mexico and Canada. One of the many advantages of buying of this company is that they are prepared to furnish any shape, style or size in woven wire brushes for any purpose and of any metal.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. JULY 29, 1896. No. 430.

Electric Lighting.

THE DETROIT MUNICIPAL LIGHTING PLANT.

THE Detroit municipal lighting plant has been used to a great extent as the text for numerous arguments pro and con city ownership during the first nine months of its existence, and as this plant is a representative one of its class a description of it, together with an account of its first year's financial operation, as shown in the first annual report, just issued by the Detroit Lighting Commission, will be of special interest.

In four successive messages Mayor Pingree of Detroit strongly urged the building of a municipal lighting plant for that city. In 1893 his last message stated reports from 92 cities owning their plants had been received and that in these cases the cost of lighting was only about one-half of what it was where the service was secured under contract. A bill to this effect was introduced in the State Legislature and it became a law on March 18, 1893.

The Common Council of Detroit authorized the issue of $600,000 in bonds to defray the cost of building and equipping a public lighting plant, and in February, 1894, the proceeds of these bonds were deposited to the credit of the Public Lighting Fund. A committee of six gentlemen was appointed by Mayor Pingree, known as the Public Lighting Commission, and this body appointed Mr. Alex. Dow as city electrician on June 14, 1893.

THE BUILDINGS.

During the summer of 1893 the commission secured eleven lots lying on the river front containing in all 64,175 square feet. On this property the office and station buildings were erected. These buildings are shown in the illustration, Fig. 2, and a rear view of the station building taken from the river is shown in Fig. 1.

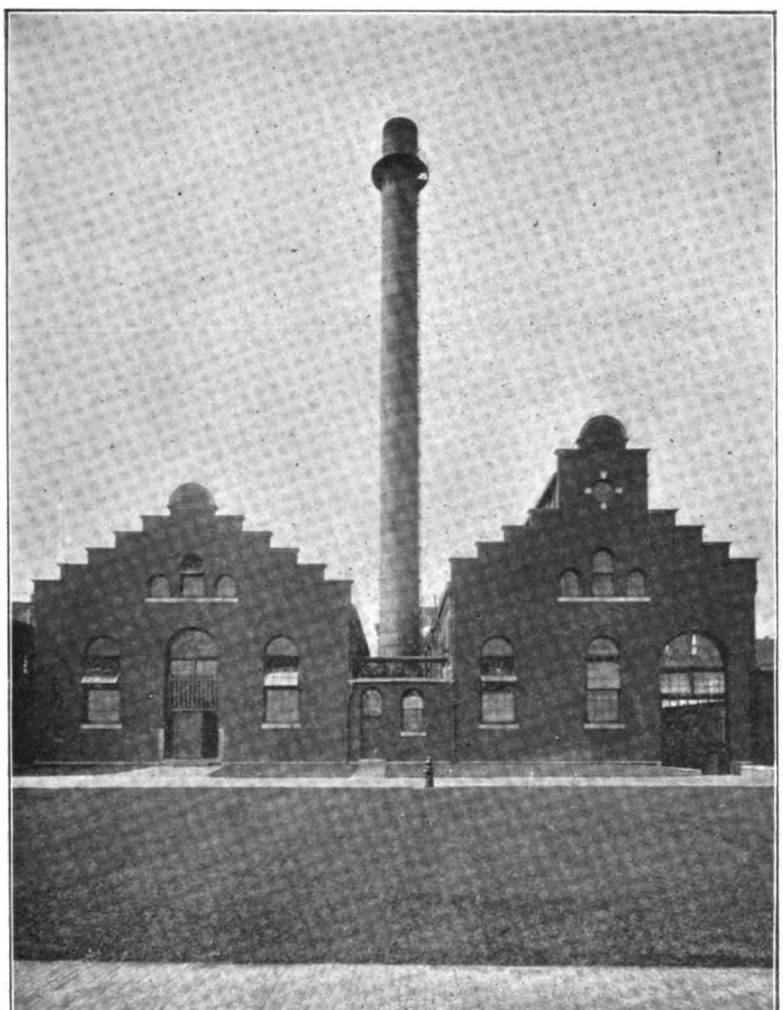


Fig. 1.—Detroit Municipal Electric Light Station. View from River.

General outline plans of these buildings were prepared by Mr. Dow, and the consulting engineer, Mr. Jesse M. Smith. In general terms these plans provided for a brick office building three stories high, having a frontage of 136 feet on Atwater street with a width of 35 feet at the west end and of 14 feet at the east end. The first floor of the office building is divided into convenient rooms for machine and blacksmith shop, storeroom, trimmers' room, carpenter shop and supply store room. The second story is devoted to the offices of the commission and secretary, the electrical engineer, draughting room and lamp repair room. The third floor is divided into two large rooms for storage of globes, patterns and bulky supplies.

In the rear of this building and separated from it by an alley 16 feet wide, is the power house, the foundations for which were made by excavating to the river level and driving 1,893 elm piles 23 feet long. These piles were capped with oak timbers and the timbers cross planked with oak. The power house contains an engine and dynamo building 50 x 150 feet in size and a boiler house 48 x 150, the two being joined together by a smaller building 17½x 150. The floors of the boiler room and basement of engine room are of artificial stone and the floor of the engine room proper is of 4-in. Norway pine plank eight feet above the basement, the plank covered with 1¼-inch matched hard maple. The small building between the engine and boiler houses contains the office of the station where the engineer on watch has his headquarters. Adjoining is a wash room with lockers for the men's clothing; shower bath and closets for the engineers. Next to this is a similar wash room for the firemen, oilers and other men about the plant. Then comes the stack room out of which rises the smokestack, built of steel plates and bricked inside, having an average diameter of nine feet and being 150 feet in height with a 15-foot foundation, making the top of the stack 165 feet above the level of the river. This room also contains the heater and hot well. Next comes the pump room, containing the condensers, fire pump and engine and dynamo for the incandescent lighting necessary in the day time. The last room next the office building is fireproof and contains tanks for the lubricating oils, kerosene oil, paints and other inflammable material.

THE STEAM PLANT.

The steam plant contains seven tubular boilers built by Chas. A. Strelinger & Co., of Detroit. Each boiler has a heating surface of 3,000 square feet, and the feed water enters through

a Hoppes purifier attached directly to each boiler. The furnaces are of the Hawley down-draft type which were selected with special reference to the smokeless consumption of soft coal. In this respect they have proved very satisfactory and the station smokestack has never given off the black discharge which usually accompanies the use of soft coal.

There are five engines, each having three cylinders 11¼, 18 and 29 inches in diameter, respectively, with a stroke of 18 inches, and running at 200 revolutions per minute. The initial steam pressure is 160 pounds and the best economy is obtained when indicating not less than 250 nor more than 340 horse-power. There are two flywheels to each engine, each wheel weighing 7,500 pounds. The engines were built by S. F. Hodge & Co., of the Riverside Iron Works, Detroit. The combined condensers and feed pumps are of the Worthington make. The exhaust steam from the cylinders of the pumps is not condensed but is used during the winter months for the heating of the buildings and during the summer months to increase the temperature of the boiler feed water.

The main system of steam piping was constructed by the station employés, the flanges being machined and the pipes cut in the commission's shop.

ELECTRIC PLANT.

The electric plant is in two sections, the first and much the larger one, being that designed for the lighting of the streets; the second being that required for the incandescent lighting of the public buildings within a half mile circle, about the station.

A very wide investigation was made by the commission during the latter part of the year 1893, and they became convinced that the only improvement to be looked for at an early date was the development of the arc lighting dynamos of 60 or 70 lights capacity into larger sizes of greater efficiency; and believing that this progress would be assisted by a call for such machinery in a plant of the size and character of the one to be installed in the city of Detroit, they prepared specifications for dynamos of 50 kilowatts output at 500 revolutions, and of 86 per cent. commercial efficiency.

A contract was entered into with the Western Electric Company for the supply of eighteen 50 kilowatt constant current dynamos for series arc lighting. Another contract was entered into with the Brush Electric Company, for the supply of 1,500 series arc lamps.

The arrangement of the station is shown in Fig. 3. There was not found in the market a satisfactory main switchboard, although a unit switchboard suitable for the operation of each group of dynamos was secured without difficulty. The commission, therefore, directed the construction, in its own shops, of the main switchboard which is a modification of the plug and cord style long in use, equipped with Weston standard instruments and with a bank of incandescent lamps for testing purposes. This board, after a year's service, has proved entirely satisfactory.

Besides the arc lighting plant there are 2,500 incandescent lamps run from this station which supply the City Hall and several municipal buildings. The machinery for this service is of the Westinghouse type. It consists of three 55 kilowatt alternatng current dynamos of the two-phase type, with transformers and station instruments. The primary voltage is 1,100; the secondary is 110 volts.

Two of these alternators are connected to the engines which run the arc lighting dynamos; the third alternator is connected to a non-condensing, compound Westinghouse engine which runs during the daylight hours, so that it is not usually necessary to operate a triple expansion engine or condensing machinery excepting during street lighting hours. The exception to this is during the two mid-winter months when the incandescent lighting load in the evening rises above the capacity of one alternator.

The eighteen arc dynamos and two alternators are connected to the five triple expansion engines in sets of four by rope driving gear. Each dynamo has seven endless cotton ropes of ⅞-inch diameter, and each of the two fly-wheels of the engine has fourteen grooves; so that the four sets of seven ropes are divided equally between the two wheels. It has not been found necessary to use any tension carriage with these ropes. The diameters of the pulleys are, on the engines 84 inches, and on the dynamos 34 inches.

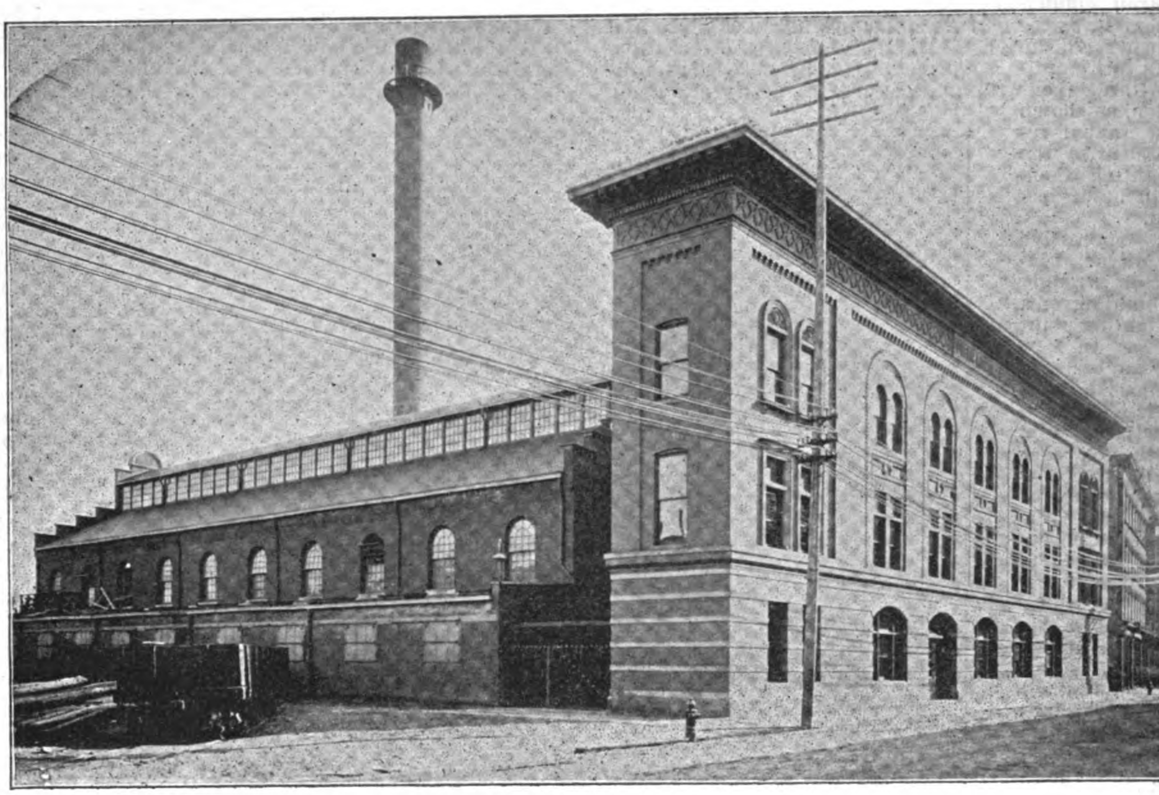


FIG. 2.—DETROIT MUNICIPAL ELECTRIC LIGHT PLANT. OFFICE AND STATION BUILDINGS.

DISTRIBUTION SYSTEM.

The distribution system is divided into two sections: The first is the underground district, in which there are connected 184 arc lamps and the 2,500 incandescent lights. The cables are rubber insulated, with tape and lead covering over the rubber. The arc circuit cables have a rubber insulation 7-32-inch thick around a No. 4 conductor. The feeder cables of the alternating system are identical with the arc cables. The mains have a 9-64-inch insulation around a No. 8 conductor. They were furnished by the Safety Insulated Wire and Cable Company, of New York.

The second section is the overhead district, which supplies all the street lighting excepting that within the half mile circle. There are connected to these lines 1,309 arc lamps. The

poles number 4,378 and vary in length from 40 to 70 feet. The location of the plant in the underground district involved a special study of the manner of connecting with the lines in the overhead district. A special line of high poles was run through the streets nearest to the river, the poles being so located as to cause a minimum of obstruction to traffic and of such height as to cause a minimum of interference in the operations of the fire department in case of fire.

As between overhead construction and underground construction the experience of the Lighting Commission is that the underground construction is infinitely preferable. The only fault to be found with it is its first cost. Underground cables will certainly last longer than overhead circuits. The conduits are of imperishable material and under the conditions of the Detroit underground insulation interruptions of service are entirely unknown.

CONSTRUCTION COSTS.

On the first day of July, 1896, the following amounts had been expended in the construction of the plant, $32,675 having been raised by taxation in 1895 in addition to the amount realized from the sale of bonds:

Land for Central Station	$63,125.00
Erection of buildings	66,661.25
Services of architects	3,453.80
Inspection, Board of Public Works	1,483.00
Dock building	3,746.60
Boiler room floor	649.73
Paving and sodding grounds	1,393.60
Sidewalks	220.69
Water intake system	2,608.21
Central Station fixtures	23,865.04
Pole line construction	107,779.81
Conduit construction and cables	87,602.53
Railway track	9,665.60
Towers	85,099.13
Engineering	16,585.25
Lamp posts	6,956.82
Steam plant	82,152.33
Arc lamps	29,628.62
Electric plant	40,842.53
Machine shop	5,378.19
Miscellaneous	2,349.54
	$641,247.27
Less sale of material, rent of lines and labor for other boards, included above	11,105.55
Net cost of plant to date	$630,141.72

OPERATING COSTS.

The following shows the total cost of operation and maintenance for the nine months from October 1, 1895, to June 30, 1896:

Coal, at $2.19 per ton	$12,208.09
Labor and management	55,821.63
Carbons	5,820.49
Oil and rags	1,149.76
Teaming	1,970.10
Globes and nets	476.40
General supplies	4,472.12
Printing and stationery	237.01
Freight and transportation	126.06
Incandescent lamps	327.70
Surgeon and hospital	194.00
Total	$82,803.36

During this nine months there was an average of 1,483 arc lamps in operation each night from one-half hour after sunset to one hour before sunrise. The total cost of $82,803.36 is divided by the Commission into two accounts, $6,606.35 for the incandescent service and $76,197.01 for the arc light service. This brings the price per arc lamp per year $68.52, and to this is added $16.18 per lamp for interest on the bonds, making a total cost of $84.70 per lamp per year, as reported by the Commission. The item of maintenance is included in the report under the items of general supplies and labor, and no charge for depreciation is made. The only cost for insurance given is $125 for the boiler insurance of $25,000.

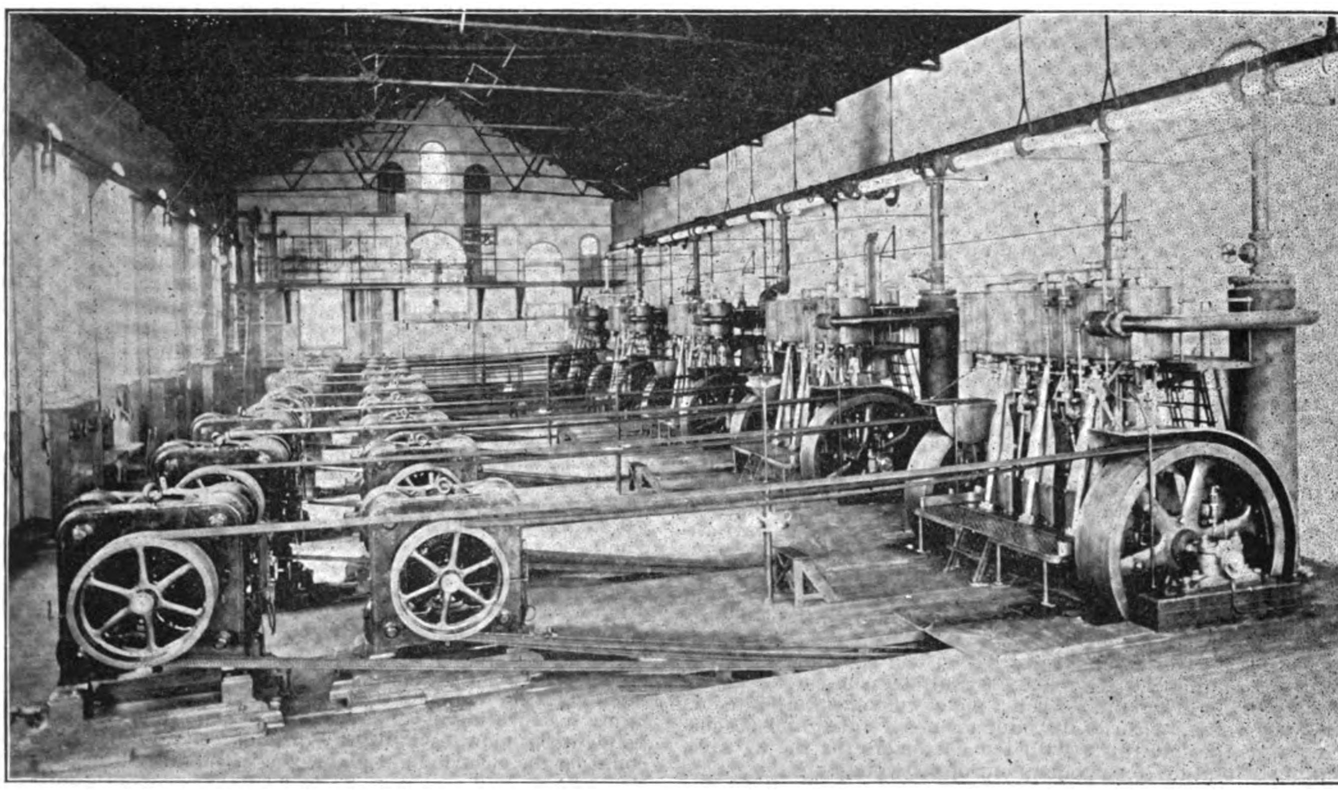


FIG. 3.—DETROIT MUNICIPAL ELECTRIC LIGHT STATION. ENGINE AND DYNAMO ROOM.

ELECTROYLTIC ESTIMATION OF THE HALOGENS.

George Vortmann described, a short time ago, a method for the electrolytic estimation of iodine, and he now calls attention in the "Monatshefte," XVI., page 674, to several important improvements in the process. An anode of pure silver, shaped like a clock-glass, a cathode of platinum or copper, and a current which does not exceed two volts in the case of cold solutions containing no alkali tartrate, or 13 volts when the solution is warm and contains alkali tartrates, are employed. The electrolysis is continued until the solution no longer gives the iodine reaction, or until a new anode placed in the solution does not gain in weight. Under these conditions, no silver is dissolved from the anode, which retains on its surface the whole of the iodine in the form of silver iodide.

MISTAKES OF MUNICIPAL CONTROL.[1]

As the question of electric lights for this city has been brought to the notice of the public by its Common council requesting the Board of Public Works to examine into the same, about six months before the contract expires, and I have been respectfully requested by the Board of Public Works to give prices on the same, I desire for the benefit of my patrons and the taxpayers of St. Joseph, Mich., to submit a few facts and some information that I have obtained personally from the South Haven (Mich.) waterworks and electric light plant, from the fact that South Haven prices have been quoted to me on various occasions as 25 cents for incandescent lights and $3.50 for arc lights, per month, same candle-power as is used in St. Joseph.

To any one not acquainted with the facts and not understanding the cost of producing electric lights, it would seem on the face of it that I am charging my customers an outrageous price for lights. When the subject has been fully considered and all the facts taken into consideration, it will readily be seen that my prices are reasonable. I will be as brief as possible with this long subject and give it as it was furnished me by the mayor, clerk, engineer and electrician of South Haven, Mich.

INVESTMENT.

Waterworks bonds (at 5 per cent.)	$40,000
Waterworks extra construction (at 6 per cent.)	2,000
Electric light bonds (at 5 per cent.)	10,000
Electric light extra construction (at 6 per cent.)	3,000
Total	$55,000

The city has to show for the above outlay the following: The power station near the lake, with two Hughes pumps, capacity three to four million gallons each per day; some 6 or 8 miles of mains and a standpipe, 67 hydrants; 378 taps and about 400 customers. The plant has been in operation for over three years.

In the electric light plant they have one Buckeye engine, cylinder 13 x 16, 240 revolutions per minute, carrying 85 lbs. of steam, three 40 horse-power boilers, one 1,000 light alternator of 2,000 volts, one 50 light arc machine, 1,200 candle-power, one Deane condenser, not in use. The dynamos are belted in tandem.

The city has 80 32-candle-power Bernstein lamps in series in the streets, consuming 5½ amperes on a 2,000-volt machine, and also has seven arc lights of 1,200 candle-power in the business district.

They have 31 commercial arc lights, one customer using 11 or 12 out of the 31. Between 500 and 600 commercial incandescent lights in circuit, with ten meter customers, at 10 cents per 1,000 watts, with no discount on meter rates and 50 customers on the flat rates, with ten customers for the 31 arcs, making a total of 70 customers out of 600 voters.

The flat rate for incandescent lights is 30 cents each for the first five, 25 cents each for an additional five and 20 cents each for another additional five or more, on a 9 o'clock p. m. circuit. If the lights are used after that time 5 cents per light additional is charged. Arc lights are $3.50 each, and $3 each for two and over, on a 9 o'clock p. m. circuit, under yearly contracts. Where arc lights are taken for less than one year the rate is $5 per month for the first three months. The station shuts down at 12 midnight and in the winter time it starts up again at 5 a. m., and runs until 7 a. m., for the benefit of the stores and houses. The incandescent lamps are 100 volt and the customers pay for renewals.

There are two oil tanks near the station, with a capacity of 6,790 and 7,800 gallons. Oil for fuel costs them $2.43 per hundred gallons. Before the electric light plant was constructed it took between 60 and 70 gallons of oil per day to run the waterworks, one tank lasting two and one-half or three months in winter. During the months of December and January it required a tank of oil every two weeks to run the two plants, making the full account $243 per month.

The city owns the meters and charges 10 per cent. rent to the customers. As will be seen, there are only 180 incandescent and 12 arc lights on sale. If new customers are obtained it will require more arc lamps and more transformers for the new customers, which means an additional cost to the taxpayers. If additional revenue is obtained the operating expenses will increase in proportion.

[1] Facts and figures presented to the Citizens of St. Joseph, Mich., by Mr W. Worth Bean, President St. Joseph and Benton Harbor Electric Railway and Light Co. [After thorough investigation the municipal plant idea was abandoned and a contract made with the company.—Eds. E. E.].

STATEMENT.

Waterworks receipts, 1895	$2,250.00
Electric light receipts (July to December 31, 1895)	1,200.00
Sixty-seven fire hydrants at $20 each	1,340.00
Seven arc lights in the streets, 1,200 candle-power, at $16 per month, until 12 o'clock only	672.00
Eighty incandescent lights in the streets, 32 candle-power, $3.46 per month until 12 o'clock only	1,663.00
Total	$7,125.00

OPERATING AND GENERAL EXPENSES.

Interest on $40,000 at 5 per cent., waterworks bonds	$2,000.00
Interest on $2,000 extra construction waterworks bonds at 6 per cent.	120.00
Interest on $10,000 electric light bonds, 5 per cent. 6 months	250.00
Interest on $3,000 extra construction electric light bonds, 6 per cent., six months	90.00
Depreciation and repairs on waterworks, 2 per cent. 1 year	800.00
Depreciation and repairs on electric light plant, 5 per cent. six months	325.00
Taxes on $5,000 valuation on $5,500 cost, at 3½ per cent. on waterworks, 12 months; lighting plant six months	125.00
Insurance on entire investment	50.00
Day engineer, 1 year, waterworks	600.00
Night engineer and electrician, 6 months at $60 per month	360.00
Trimmer, six months at $35 per month	210.00
Waterworks superintendent, 1 year	40.00
Clerk, 2½ per cent. for collecting all money	86.25
Fuel 1 year	1,800.00
Lubricants, $110; waste, $15	125.00
Carbons, globes, street lamp renewals, packing for water pumps, packing for engine and other pumps, dynamo brushes, etc.	143.75
Total	$7,125.00

It will be found from the above figures that the seven street arc lights cost the city $16 per month each until 12 o'clock midnight, and the 80 32-candle-power incandescent street lights cost them $3.46 each per month, until midnight, when any private company would be glad to furnish them arc lights at $7 per month each, and incandescent lights at $1.50 each for 32 candle-power until 12 o'clock midnight, in small quantities and at $1.25 for 80 incandescents, and still make a reasonable profit.

It must be borne in mind that the depreciation and repairs on waterworks plant is only 2 per cent. and on the electric light plant is only 5 per cent., which makes the price, as above stated, $16 per month per light for arc lights, and $3.46 per month per light for incandescent lights for streets. If you will figure a depreciation and repair account of 4 per cent. on the waterworks plant and 10 per cent. depreciation and repair account on the electric light plant, you will find that incandescent street lights will cost them $5.80 per light per month until midnight.

It is claimed by some waterworks men that 4 per cent. for the depreciation and repair account is low enough for a period of ten years on a waterworks plant, and it has been fully demonstrated that at the end of ten years, if the electric light apparatus should be put on sale it would be found to have depreciated fully 80 per cent. A further fact is that nothing has been figured on for a sinking fund with which to meet this debt at the end of ten years, or twenty years, as the bonds may run. If the bonds run for ten years an additional 10 per cent. must be figured and if they run for five years an additional 5 per cent. must be figured and added to the above prices or the city will owe the entire debt when it becomes due, and the entire payment of this debt does not lessen the investment as it stands as cash paid out, whether by a private company or municipality.

This plant had to be figured as a combination plant, as steam is provided by the waterworks boilers and the electric light plant is operated in the waterworks station.

What will interest consumers and taxpayers most are the following figures: If the South Haven street arc lights are charged at $7 per month and the incandescent street lights are charged at $1.25 per month for a 32 candle-power, it will readily be seen that the city of South Haven, in order to furnish her present customers lights at a trial cost would have to charge them $5.03 per month per light for the $3 arc lights and $5.53 per month per light for the $3.50 arc lights, and 65 cents per month per light for the 30-cent incandescent lights, 62½ cents for her 25 cent lights, and 60 cents for 20 cent lights, taking as a basis that her 20 cent lights averaged 25 cents and her 30 cent lights

averaged 27½ cents, and this is all figured on the 9 p. m circuit, after which time 5 cents should be added to each amount for incandescents, making 70 cents, 67½ cents and 65 cents respectively, until 12 o'clock.

The city of South Haven, or any other city, has a right as the law stands to tax the entire taxpaying community and furnish electric lights to customers at less than cost, but the proposition is not legal and it is not a fair business transaction to all taxpayers concerned.

It is supposed from the above figures that South Haven would not have as many customers at the proper price as she now has at the low prices, which would make matters still worse as to the cost of production. The above facts explain how 70 customers out of over 600 voters and taxpayers (and every voter is a taxpayer, directly or indirectly) gets electric lights at 50 per cent. of the cost of production, while 530 citizens are all called upon to make up the deficit. The price of street lights, both arc and incandescent, as paid by the taxpayers, is out of all reason.

My reception in South Haven was courteous and gentlemanly and I have the kindest words and expressions for the city and her officials, but they evidently have not had the experience which should teach them not to sell goods at less than cost. The Mayor explained to me that municipal ownership was brought about by a young man who had a dynamo in the city, and received his power from a sawmill engine, sending notices to the citizens that if a certain number of lights were not subscribed for within a given time he would remove his dynamo from the city. Hence, the citizens of South Haven, in order to keep their city from being left in darkness, put in a municipal plant, which I am informed would not have been done only under these circumstances.

The report of the clerk to me in detail may change these figures a few cents in regard to carbons, globes, and fuel, but the other data will be found correct. I believe the figures given by the officials are true, and that I have shown that my prices have been reasonable and I will look after the welfare of my customers in the future as I have in the past.

ALTERNATING CURRENT MOTORS.[1]

BY DUGALD C. JACKSON.

Messrs. J. H. Perkins and W. H. Williams undertook last winter to make careful comparative tests of alternating current motors in my laboratory. Five horse-power, alternating current motors of the following American makers were available for the purposes of the tests: Fort Wayne Electric Corporation, single-phase; Stanley Electric Manufacturing Company, two-phase; Westinghouse Electric and Manufacturing Company, two-phase; General Electric Company, three-phase. A 5 horse-power three-phase made by the Allgemeine Electricitäts Gesellschaft of Germany, was also included in the tests, and results of tests on machines made by the Oerlikon works and by C. E. L. Brown, of Switzerland, were obtained. A 10 horse-power Westinghouse two-phase was also tested. A capacity of 5 horse-power in the motors to be tested was chosen, as that may be considered to be near the average capacity of motors used in the service of ordinary central stations. The results of the tests may, therefore, be accepted as representing, for the central stations, comparative results between the average motors which they may use on alternating current systems, and the results may also serve as a basis for comparison between average conditions of operating with continuous current and alternating current motors.

When Silvanus P. Thompson wrote his book on polyphase currents, in 1895, he set forth as the requisites for a good alternating current motor that: 1. It shall exert a good torque at starting. 2. It shall be capable of running at a nearly constant speed at all loads. 3. It shall yield in mechanical power a high percentage of the power put into it. That is, it shall have a high commercial efficiency.

There are three additional requisites which Professor Thompson overlooked, but which determine to fully as great an extent the success of the motor. These are: (a) The motor shall have a high power factor; (b) it shall not require an abnormally large current from the lines at the instant of starting; (c) it shall not cause a large unbalancing of the pressures on the lines of a polyphase circuit.

The requisites, (a), (b), and (c), are so important that if they are overlooked, a motor cannot give satisfaction to the central station man. Messrs. Perkins and Williams made tests of the following points: (a) starting torque and current; (b) speed regulation; (c) commercial efficiency at all loads; (d) power factor at all loads; (e) starting current; (f) effect on the line pressures when starting.

The results of the tests were shown in a table and a series of curves.

Four out of the six motors tested affected the incandescent service disastrously, and showed the absurdity of attempting with them a combined service on the same circuits as the incandescent lighting in those plants where regulation and the satisfaction of the customers is considered of importance. The tests show that the alternating current motors give equally satisfactory regulation and efficiency as is given by continuous current motors, but the power factors of most of the machines are small for part load, the starting currents excessive, and the starting torques with the present arrangement of starting resistances are unduly small. The best performance of the American 5 horse-power machines lies between No. 3 and No. 5 of the tables. These machines will stand well above the others. They are about even in starting torque, but No. 5 will carry considerably the higher load before dropping out of its pace; No. 5 also regulates the better and has the higher efficiency. On the other hand, No. 3 has a power factor incomparably better than any of the other machines.

The author then showed how the question of efficiency and power factor affected the central station. The power factor strikes the central station directly, since a low power factor causes an increased current output, with an accompanying increased loss in the lines and transformers, and, even worse, with a demand for an excess capacity and therefore of cost in the generating machinery and transformers.

The question of power distribution for alternating current stations, as it now stands, resolves itself into this: 1. If you have a 500-volt, continuous current power service, stick to it. 2. If you can develop a large power service within a radius of two miles from the station, put in a 500- volt, continuous current outfit. 3. If you can develop a small power service only, which can not afford a duplication of apparatus, or your distances are excessive, then arrange to use alternating current motors. 4. In this case, arrange to operate all the lamps on one phase to avoid, as far as possible, difficulty in regulation, and use such a generator and system of lines as will enable the use of motors. 5. Motors intended for such use should be guaranteed to have a high power factor and to start without taking an excessive current from the lines. 6. Never use recording amperemeters with alternating current motors if you really intend to develop a power service, but use recording wattmeters to indicate the power absorbed by the motors. 7. Where two-phase or three-phase motors are used, place two recording wattmeters, properly connected, to indicate the total power by summing their readings. (A single special meter, made up to serve the purpose of the two, may be used, but such an instrument is not now on the market as far as I know.)

This summation is based on the assumption that uniformity of pressure at the lamps is valued by the central station man.

[1] Read Before the Northwestern Electrical Association.

CENTRAL STATION INSURANCE.[1]

BY C. C. PAIGE.

The subject of insurance which I am requested to take up for the purpose of getting it before this convention for discussion is of great importance to central stations. There was a time when insurance companies advised their policy-holders, and the public generally, that there was less liability to fires in buildings lighted by electricity than in those lighted by any other method. These statements became common talk and were used by central station owners in soliciting business. It is not so now; the insurance companies serve a notice on the policy-holder that is lighting by electricity that a survey of the electrical equipment of his premises had been made on a certain date, the general condition of which was poor or very bad. The summary of defects and specifications for changes and improvements discloses the fact that nearly or quite all the material, including wire, in most cases, must be thrown aside and other materials substituted in its place. Thirty or sixty days are allowed for the changes to be made, and if they are not made within the specified time, the insurance rate will be raised 50 per cent. This course is taken in all localities with which I am familiar. The cost of making these changes is not an insignificant item, and causes more or less trouble between the property owners and the wiring company who did the work originally. In some cases the electric service has been suspended on account of the failure of the interested parties to make the improvements required. Here the question naturally arises, Are these changes and improvements necessary to prevent fire and accidents? In localities in which the electric service has been used for ten years or more without the record

[1] Read Before the Northwestern Electrical Association.

of an accident to man or beast, or a fire even of the most insignificant nature, the answer from the property owner and the wiring company would naturally be, No. All of these requirements are not necessary; poor material and improper workmanship has probably caused the insurance companies to be alarmed even when fires and losses have not occurred. I am of the opinion that the underwriters' rules for wiring and installing electric apparatus for both public buildings and residences could be somewhat modified, thereby making quite a saving on the first cost of the installation, and not in the least depreciating its efficiency or safety. It behooves the central station operators and managers to watch carefully the cost of wiring and installing electric service, otherwise electricity will attain the unpopular reputation of being a luxury that only the rich can afford.

I hope this question, which is of great importance, will be freely discussed by electricians and wiring experts, and their suggestions and recommendations be adopted by this association.

THE INSURANCE OF ELECTRICAL PLANTS.[1]

BY R. H. PIERCE.

One of the most serious problems to the owner or manager of a central station is the reducing of the fire hazard to a minimum. The problem of safety is the real question, and when this is solved we at the same time solve the problem of insurance.

In the opinion of the writer, the insurance question which the central station manager has to answer is simply the question of making his plant insurable. This may appear to be a radical view, but I believe it is logical. A large proportion of existing plants were installed at a time when the electrical manufacturers and electrical constructors did not understand what materials and methods should be used in order to secure safety; and finally, and worst of all, many plants have been installed by companies or individuals whose only thought was to get the largest price for the cheapest installation, leaving the unfortunate station owners and managers to wrestle with the question of safety, as well as those of reliability and economy. But however serious the question may be, it must be met and if attacked in the right way, the solution may not be as difficult as it at first appears.

The results of a central station fire are twofold: First, there are the losses due to interruption of service, and second, there is the loss of plant. I have placed the losses due to interruption of service first, as these must be considered whether we consider the question of insurance or not. The interruption of service for any considerable time or a decrease in patronage due to irregular or uncertain service may, and often does, mean a difference in revenue, which is the difference between a profit and a loss in the operation of the station, and operating a station at a loss is worse than losing it.

The way to secure safety and reliability is to have proper construction and proper care, protection and attendance. The proper methods for securing safety are laid down in the rules and requirements of the National Board of Fire Underwriters and are well known to all engineers and constructors of any standing.

The question of insurance can be met in three ways: 1st, by insuring in responsible and reliable insurance companies; 2nd, by the formation of a mutual company by central station owners; 3rd, by securing the maximum safety through the use of proper construction, care and fire protection, and taking the chances of a fire loss.

As a general proposition the only reasonable course is the first one indicated, namely, the insuring in responsible and reliable companies. The plan of forming a Central Station Owners Mutual has been "weighed in the balance and found wanting." Theoretically, it may be possible to form such a mutual company, but it would be an additional burden to the central station business, which I take it has trouble and problems enough to face already. If fire insurance is a legitimate business,—and it appears to be as legitimate a business as electric lighting—, then we may as well assume that the insurance people know their business and that the competition between insurance companies will produce as low a rate as could (with equal protection) be given by a mutual company. The third method mentioned, of securing maximum safety and then taking the chances, may be the best in some, but only in very special cases. If the central station plant is so designed, installed and operated as to reduce the fire hazard to a minimum, insurance companies will ask a minimum rate of insurance which, in most cases, will be so small as to be no burden to the owners. Discarding then the two plans just mentioned, we are brought to the first plan of insurance in reliable companies. Accepting this as our line of action, the problem now is to so install and operate our plants that the hazard is reduced to a minimum or at least to a point where further improvements would increase the cost out of proportion to the additional safety secured.

Before this point is reached, we will usually have secured a plant in which the fire hazard is very small and on which the insurance rate should be surprisingly low. We must not figure too close on our investment. Even if the interest on the added investment is equal to the amount saved by reduction of premiums we are ahead, as the improved construction, care and attendance, means a smaller chance of interruption of service and usually better service, less repairs and smaller depreciation.

The great problem is, as I have said, how to best secure safety. Competition in the electrical manufacturing and construction business has not led to increased safety. On the contrary, it has led to cheapness in both appliances and methods and cheapness does not mean safety. On the other hand, we must not think that we must be extravagant in order to have safety. The use of proper methods of construction and of intelligence and care in operation are what is most necessary to secure safety. If, however, we cannot look to the electrical companies for protection, to whom shall we look? Who should judge of what is necessary for safety? Who has devoted most time and thought to this subject? The National Board of Fire Underwriters beyond a doubt. Whether we insure or not, the regulations of the Underwriters are to-day the best, and we may say only, guide to safety. Their requirements can of course be improved, but the insurance people are ready and anxious to receive suggestions from all engineers and central station men. I sincerely believe that a study of the requirements of the Underwriters, and a free discussion of their merits by central station men and engineers is the one thing that will lead to an understanding of the insurance question and will eventually lead to an understanding between owners and insurance companies, which will be mutually satisfactory.

Everyone of the Underwriters' rules represents thought, investigation and experience, and if time permitted, it would be profitable for us to discuss each rule by itself. I shall have to be content, however, with calling attention to the rules and to a few lessons which they seem to teach.

The base rate or the rate of insurance for central stations which conform in all respects to the requirements of the underwriters is 50 cents per $100. For every point in which a station fails to conform to the requirements, a certain addition is made to the rate.

The underwriters recognize thirty-four specific causes for raising the rate above the base or minimum amount. These causes are violations of the rules and regulations, and do not consider "External fire protection," "Other occupancy, "Condition," "Exposure." A specific addition is made to the rate for inadequate fire protection, and an addition is made for other occupancy, condition, exposure, according to hazard. The thirty-four causes just mentioned are all violations of the regulations concerning construction of building, electrical arrangements, or care and attendance, and are therefore, all causes within the control of the owner.

These thirty-four causes may, if they all exist, raise the rate to over $10 per $100, but of this sum, over $5, or more than half the amount, is due to the following causes: Improper arrangement of stack, defective wiring, improper construction of switch board, improper construction and placing of rheostats, storage of oils, gasolene, etc., in station and improper storage of ashes. All of these are defects that should and always can be avoided, and usually at small expense.

Time does not admit of taking up the thirty-four violations separately, but I can cover the ground in a general way by saying that if a station was built and operated so as to be defective under all or the majority of the thirty-four counts, an intelligent man would consider that it was only a question of time when it would burn down. The additions to the rate are not unreasonable. The causes for which the greatest additions are made to the rate are conditions which no sensible man would allow to exist in his station. In most cases a station can be designed or remodelled by one familiar with the underwriters' requirements so as to have a very low total rate and without any extravagant expenditure, and where the surroundings are favorable, a station can be cheaply built which can be insured for the minimum rate, or very close to it.

[1] Abstract of a paper read before the Northwestern Electrical Association.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has a contract for furnishing steel trusses for the new building which is to be erected by the Holyoke Gas Company, of Holyoke, Mass. The building is 50 feet wide and 60 feet long. Roof trusses are entirely of steel, and the covering is slate. No woodwork or inflammable material will be used anywhere in the construction.

THE RIGHTS OF ELECTRICAL COMPANIES.[1]

BY W. CLYDE JONES.

THE subject will be discussed under three principal heads: (1) the relation of the electrical industry to the governing power upon whom it depends for the exercise of the essential franchise for the use of the streets and highways; (2) the relation to private persons and abutting property owners, and (3) the relations between various companies, electrical and otherwise, which conflict in the exercise of their franchises.

There are few electrical pursuits which do not require for their proper exercise the enjoyment of a public franchise, as the right to use the public streets or highways for the placing of their wires and conductors. The obtainment and enjoyment of such a franchise brings the electrical company into contact with the governing power of the community. But though the government may permit the company to exercise a franchise, the franchise cannot be exercised in derogation of the rights of others without due compensation therefor, and this brings into consideration the much vexed question of the relation of the company to the abutting property owner.

The modern view relieves the inquiry of legal subtleties and reduces the inquiry to a simple question of fact as to whether the new use does or does not affect the enjoyment of the street by the property owner, and, if so, to what extent? The tendency of decision, however, is toward the view that the use of the street for electric light wires is a proper use of the street, not imposing a new burden on the street such that abutting property owners must be compensated.

It is argued that the telegraph is not a use of the street for its original purpose of transportation, and therefore introduces a new burden. On the other hand, it is argued that the use of the streets for the carrying of the mails and the carrying of messages is one of the contemplated uses, and as the telegraph serves the same purpose, thus relieving the streets to that extent, the telegraph is a proper street use.

The telephone has also called the streets into service for its pole lines and has been attacked on the same grounds as the telegraph, since the telephone is but one form of telegraph. The argument may be made with more force, however, that the telephone assists in the use of the street for transportation purposes, hence the many telephone conversations relieve the streets of the passage of the individuals who would otherwise have to meet in order to hold the conversations. The tendency of decision is nevertheless toward the view that the telephone imposes a new burden on the street for which the property owner is entitled to compensation.

Considering the conflicts which arose in the operation of electrical franchises the first disagreement arose between the telephone companies and the electric light companies. The variations of the currents used for electric lighting induced currents on the telephone lines where the lines ran parallel, thus introducing disturbances on the telephone lines, materially impairing the operation of the telephone system. This disturbance led to suits by the telephone companies against the electric light companies.

A more serious controversy, however, arose between the telephone and the electric railway. Most of the telephone lines had ground returns, thus employing the earth as a part of the electrical circuit. The electric railway likewise employed the earth as a part of the circuit, and the earth at different points along the electric railway was thus charged to a considerable difference of potential, such that telephone lines grounded in the vicinity of these points were traversed by currents which rang the bells, operated the apparatus and otherwise disturbed the system. At the same time trouble was experienced by the inductive action of the electric railway currents upon the telephone lines. The telephone companies brought suit against the electric railway companies to enjoin the use of the earth as a part of the electric circuit of the railway.

The next serious conflict arose between the electric railways and water and gas mains. The earth currents of the electric railroad travel along the water and gas mains. The result is the decomposition of the metallic pipes, resulting in the eventual destruction of the pipes. Suits have been brought against the electric railway companies for damages done to the mains, but as yet no decisions of the ultimate courts have been reached.

It is a well established doctrine that every one should so use his own as not to interfere with the rights of others, and it would therefore seem to be the duty of the electric railway companies to so operate their systems as not to interfere with mains laid in the street, and, if the use of the ground circuit is essential, to devise some means to prevent deleterious action upon the pipes. A number of methods have been proposed which are claimed to prevent the destruction of the pipes, and if this be the fact the question arises whether the courts will not hold the electric railway companies responsible for damages done to the mains when it is within their power to prevent such damage by the employment of available means.

[1] Abstract of paper read before the Northwestern Electrical Association.

LIGHTNING ARRESTERS.[1]

BY W. R. GARTON.

The lightning arrester, pure and simple, is nothing more than a convenient path or outlet from the condenser or charged body to a point of lower or no potential. By this we mean that a certain body has by contact or communication with a statically charged body, which may be air, wire or what not, become charged with the influence predominating the adjacent body, or in other words the originally charged body, which, in this instance, is the atmosphere, has given off to the conductor, which it surrounds, the same influence which pervades it, until the conductor has attained a high electric potential. Oftentimes the opposite conductor is far from being equally charged, and in this case a great strain is brought to bear on the insulation between the two sides of the circuit. To relieve this strain the little device known as the lightning arrester is used.

The simple and fundamental principle of the lightning arrester is some form of an air gap with serrated or plain surfaces. The only changes made have been the addition of circuit interrupting or arc prohibiting features which the different currents employed have necessitated. The success or failure of lightning arresters in general can be attributed mainly to the successful or unsuccessful performance of the duties devolving upon these additional features.

There have been very few of the numerous forms of lightning arresters devised which have not in one form or another employed the air gap. The chief reason for the employment of the air gap, in preference to that of substituting some form of resistance, is that it is of variable resistance depending upon the conditions; under ordinary circumstances it is a splendid insulator, but to a discharge it offers far less impedance than an artificial resistance of much less resistance.

It is found also that the dynamic currents of high potentials will leap certain air gaps and permanently establish a flow. Thus we have to guard against the employment of too small an air gap and still not have it so large as to prohibit a free passage of the discharge. Having determined the proper and most advantageous air gap, we have yet another problem with which to baffle; that is, a means of automatically opening the lightning arrester circuit, should an arc be established.

At this point we have all come to a halt. There are, however, a few who apparently have employed better methods than others, and have been enabled to get very good results. One of the original ideas for accomplishing the desired effect was the addition of a fuse to the air gap, so that when the flow of current was established the fuse would be blown, and in this manner the circuit restored to normal, but we were not satisfied with this form of an arrester, for we wanted something which did not require constant attention aside from being unreliable in case of discharges following in quick succession, and thus proving a constant source of annoyance.

The next step in advance was the increase in the number of fuses placed in multiple. But even this must be carefully watched and regularly inspected. To overcome the annoyance of blown fuses and interrupted service, various methods have been employed. Among those best known is the "air jet arrester," which automatically blows out the arc by a jet of air forced from a chamber in which an arc has been established in series with the outside arc. By the expansion caused by the heating of the air in the chamber the air is given impetus, and when directed upon the arc it tends to blow it out; but even this form of arrester proved inadequate and unsatisfactory.

An early principle and one which is recognized to-day as fundamental, is that of the magnetic blow-out with which you are all familiar. Other and various forms have been used—such as the iron and mica washers, "Keystone," "tank," etc., but in many of these forms either the mechanical portion has been a drawback or the construction was such as to render a barrier rather than an inducement to the discharge.

The tank arrester has in most instances proved very satisfactory. The two chief drawbacks are the constant consumption of energy while in circuit and the possibility of a storm approaching without warning and finding you without your tank cut in.

I think that I may safely say that there are three forms of

[1] Abstract of a paper read before the Northwestern Electrical Association.

arresters being used to-day which are considered standard. They are the Wurts non-arcing, the G. E. magnetic blow-out, and the Garton. In the non-arcing and magnetic blow-outs different methods of construction are employed in dealing with the various currents, while in the Garton the same form and same principle enter into the arresters for all of the different currents.

After describing the two former arresters, the author stated that in the Garton arrester the idea is to provide the best possible course for the discharge and to instantly cut off the current flow after the discharge. This is done by providing as straight a path as possible, with ohmic resistance reduced to a minimum and no inductive resistance at all.

In the Garton arrester, that which prohibits the constant consumption of energy or the flow of normal current to earth is the employment of an air gap. After the discharge has leaped the air gap and a flow is established, the small coil or solenoid becomes a magnetic field and the small plunger is suddenly drawn from its contact in the tube. The act of drawing the plunger from its contact establishes in the circuit a secondary arc which, being in series with the originally established arc, instantly interposes an additional resistance which goes on increasing by reason of its lengthening until the circuit is broken. Another means of destroying the arc is that of elongating it in the tube which prohibits its assuming its natural form. The element of time also enters greatly into this device from the fact of its being mechanical in its operation.

True it is that in many instances lightning arresters have not proved a source of protection, but in nearly every instance it will be found that the fault lies somewhere in the installation and not in the apparatus, which is generally the first to be condemned.

Trouble invariably occurs in circuits which are inadequately equipped. No station, whether direct or alternating, should be operated without the insertion into every feeder of a kicking coil in conjunction with the lightning arrester. This applies to street railways as well as stationary motors, but it is not necessary on series arc circuits. Different circuits require different localities for the installation of arresters. For instance, on railway circuits we equip each car and station feeder and scatter them along the line at varying intervals from one-half to one mile apart, and at the terminals, while on alternating circuits we place arresters at the individual transformers or banks. But there is one thing that should not be tolerated, and that is to make a lightning arrester a part of or in any way connected with a transformer. It should be the purpose to keep the lightning just as far from the transformers as possible, for, although of high inductive resistance they can very rarely ward off disruption unless they are supported by some good lightning arrester.

THE RECONSTRUCTION OF THE ROYAL ELECTRIC LIGHT CO.'S MONTREAL STATION.

In reply to an inquiry we have received the following interesting account of the work of reconstruction now being carried out in the Montreal station of the Royal Electric Company, under the direction of Mr. P. G. Gossler, the company's electrical engineer:

We are practically turning this station inside out, as you may judge from the following outline of work which we are now carrying out. We are replacing seventeen alternators by five 300 kilowatt, two-phase generators, doing away with all line shafting, belting the generators directly to three engines, which practically makes 600 kilowatt units on two of the engines; the many advantages to be gained by doing this are obvious.

We are building an entire new switchboard for serving light and power from the same two-phase circuits. This switchboard construction, we think, is as good as can be found. It consists of a white oak frame work, covered with a layer of asbestos; over the asbestos is a layer of mica and for mechanical protection the edges are protected with angle fibre. Upon this board will be mounted the different instruments, switches, etc. This framework is mounted on an iron structure with slate base, the whole overlooking all of the generators and engine room.

We are rearranging all of our lines for two-phase work, and changing our present system of 1,000 volts to a 2,000 volt system. We are also replacing all of our transformers by modern transformers, making as many small secondary systems as possible. We have so far decreased our station leakage load, within the last three months, by about 200 amperes.

In connection with this we are making preparations to receive power from Chambly Falls, located fifteen miles from Montreal. This will allow of our present steam plant being used as spare capacity, also the present 300 kilowatt generators, which we are installing will, more than likely, be used as synchronous motors for operating our city lighting arc machines.

At Chambly Falls there will be wheels and generators installed for the generation of 20,000 horse-power, which will be transmitted to this city at a pressure of 10,000 volts.

The changes we are making at the present time must eventually be made by all light and power stations if they propose to meet competition.

EXHAUSTING INCANDESCENT LAMPS BY CHEMICAL MEANS.

A method of exhausting incandescent lamps has been described in the "Zeitschrift für Beleuchtung," in which a chemical process is used in conjunction with the air pump. It is stated that most of the lamp factories in Germany are now using such chemical processes. In the tube attached to the lamp for exhausting it a piece of amorphous red phosphorus is introduced, the amount of which must be found empirically for each type of lamp. While it is being exhausted with the pump, this tube is heated carefully with a Bunsen burner; and when the vacuum is sufficient, the normal current is passed through the lamp and then increased gradually up to about three times the normal voltage, when a violet light will appear at the end of the filament. A few moments later a blue light will appear around the filament. The current should be reversed frequently, and after having run for 10 to 20 seconds at the high voltage the blue light will expand throughout the whole globe, and at that moment the lamp must be sealed off so as to include the phosphorus. The lamp is then run again and heated at the tube which contains the phosphorus. A reaction will suddenly take place and the blue light will disappear, a scarcely visible light-brown deposit being formed on the glass, which, it is said, does not affect the candle-power. When a lamp exhausted in this way is tested with a Ruhmkorff coil, neither phosphorescence nor a current will be found to exist.

ROENTGEN RAYS.

EFFECT OF ROENTGEN RAYS ON GERMINATING PLANTS.

One of the earliest recorded experiments with Röntgen rays in regard to their effect on plants is given in an article by Alfred Schober, presented to the German Botanical Society. Schober was led to the investigation by the similarity between X-rays and ultra violet light, which was pointed out by Röntgen in his first paper. The subject appeared particularly worthy of investigation, as Sachs had shown that heliotropic curving is incited in plants by blue, violet and invisible ultra violet rays in about an equal degree with full white light; while the red, yellow and green parts of the spectrum are apparently inactive. Rothert in his extensive work on heliotropism found that the cotyledo or leaf-like organ in the form of an almost cylindrical closed sheath which appears first after the roots of germinating oat plants to be particularly sensitive to the action of light, and these were thus selected for the experiment. Vigorous plants germinated in full light, with cotyledos from 1 to 2 centimetres long, were selected and set in damp sand in a dark box, the walls of which were about 1 centimetre thick and blackened on both sides. A Hittorf's tube was placed at one end of this box at the height of the seedlings and about one centimetre distant from the box. The seedlings were arranged at one end of the box so that they were about 2 centimetres distant from the tube. The inductor had a spark length of about 12 centimetres, and was kept at its highest capacity during the experiment. A photograph of a hand could have been taken under the same conditions at a distance of 30 centimetres in five minutes.

The plants were first exposed to the action of the rays for 30 minutes, after which an examination showed that no apparent effect had been produced. The box was then closed and the exposure continued for another half hour. A careful examination at the end of this time led to the conclusion that no visible effect had been produced. It was found impracticable to continue the experiment longer, as the tube in this time had become excessively heated.

After the experiment was concluded the plants used were proved to be normally sensitive, as an exposure of one hour to diffused daylight, passed through a small horizontal slit, resulted in a noticeable curvature which in four hours had reached 60° from the vertical.

As the coil was excited to its greatest capacity during the experiment, the plant being placed in as close proximity to the light as possible—and as after the experiment the plants were found to be normally sensitive, showing noticeable curvature on an equal exposure to diffuse white light—the author concludes that the new rays appear to differ from light in that they do not stimulate heliotropic curvature.

Power Transmission.

TEST OF AN OTIS ELECTRIC ELEVATOR WITH LEONARD MOTOR CONTROL SYSTEM.

BY W. H. MAC GREGOR AND R. T. KINGSFORD.

THE great increase in the number of electric elevators now in use and the sufficiency of reliable data as to their cost of operation led the writers to undertake a test of an Otis electric elevator on the Leonard system in the Fahys building, Maiden Lane, New York. Being undertaken as a graduation thesis and not in the interest of any person or concern, our only object could have been to arrive at the facts.

An inspection of the cards, Figs. 1 and 2, will show the impossibility of indicating the engine in the ordinary way. The pencil was kept on the paper during the entire up and down trip of the car, the time in each case not being over thirty seconds. An apparatus was therefore devised, which will be described later.

Method of Making the Test.—By measuring the power supplied at the steam engine and that supplied in the form of electric energy to the fields of the dynamo and motor, the total energy supplied to the system becomes known. Comparison with work at the elevator gives efficiency, and using the proper figure for the evaporation of the boiler the economy is determined.

Description of Elevator Plant.—The elevators are of the drum type with a counterpoise of 1,100 lbs., the design being that the weight of the counterpoise should exceed the weight of the empty car as much as the fully loaded car exceeds the weight of the counterpoise.

The drum is driven by a separately excited Eickemeyer motor through a worm of high efficiency running in oil. Connected directly to its brushes is the armature circuit of the generator. This dynamo is directly connected to a high-speed 10 x 10 Harrisburg "Ideal" engine and has its fields separately excited from the same source as the motor; the only difference being that the magnetic field of the dynamo can be varied in intensity and direction at will by the rheostat and lever in the car.

This method of regulation by governing the intensity of the field of the dynamo instead of cutting down its external circuit by resistance and thus wasting energy in heat, is claimed by Mr. H. Ward Leonard, the inventor, to give increased economy, as the current is supplied at a voltage corresponding to the speed of the motor.

Description of Apparatus.—To indicate the engine two ordinary indicators were used as a basis. To the one at the head end was attached a bracket supporting a roll of paper. This paper was unrolled and drawn by the drums of both indicators by rubber rollers fastened to a bracket on the indicator at the crank end. The rubber rollers were driven by belting and countershaft from the shaft of the engine. The indicator pencils being pressed against the paper, traced continuous wavy curves from which the indicated power of the engine could be calculated for any instant.

The water used by the engine was determined by weighing the exhaust condensed by means of a surface condenser. As the fields of the dynamo and motor were both separately excited a plating bath was introduced to measure the variable current.

Details of Test.—Six tests in all were made with loads of 300, 1,100 and 2,200 lbs. in the car, both with and without stops. The i. h. p. of the engine for each test was plotted as a curve having horse power as its ordinate and time for its abscissa. One of these curves is shown in Fig. 3. It will be noticed that the work on the down trip is less than that on the up, due to the work supplied by the descending load. The effect of the six stops is clearly shown by the negative area.

Ordinary cards taken at one of these moments of negative work are shown on Fig. 4. The engine is clearly being accelerated by the dynamo running as a motor, driven by the motor, running as a dynamo, caused by the inertia of the load and counterpoise.

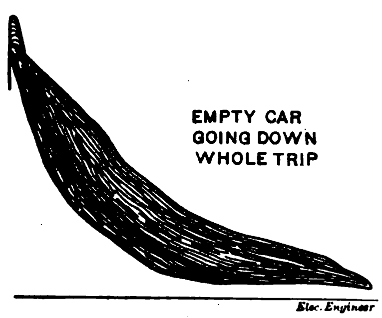


FIG. 1.

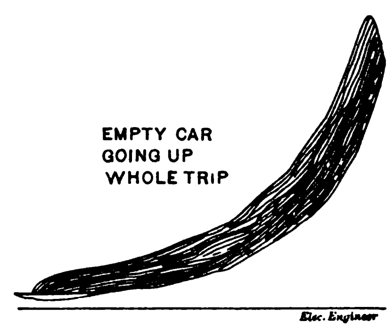


FIG. 2.

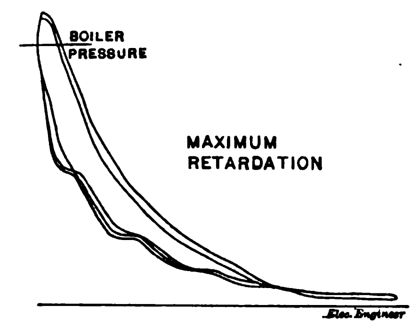


FIG. 4.

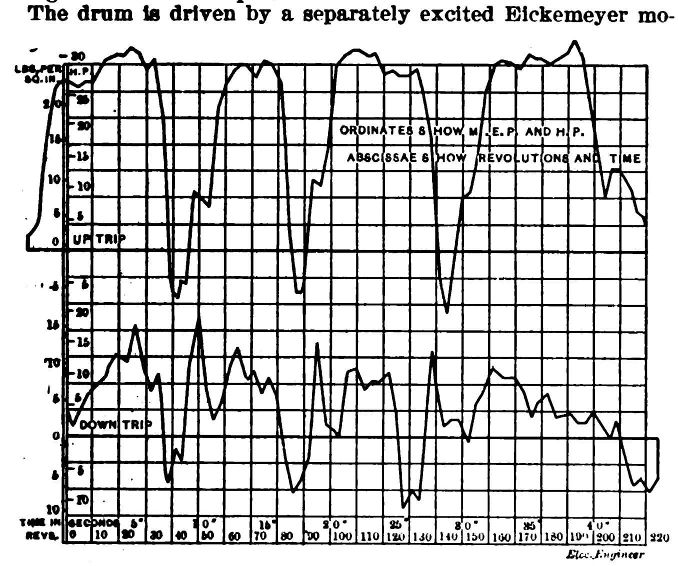


FIG. 3.

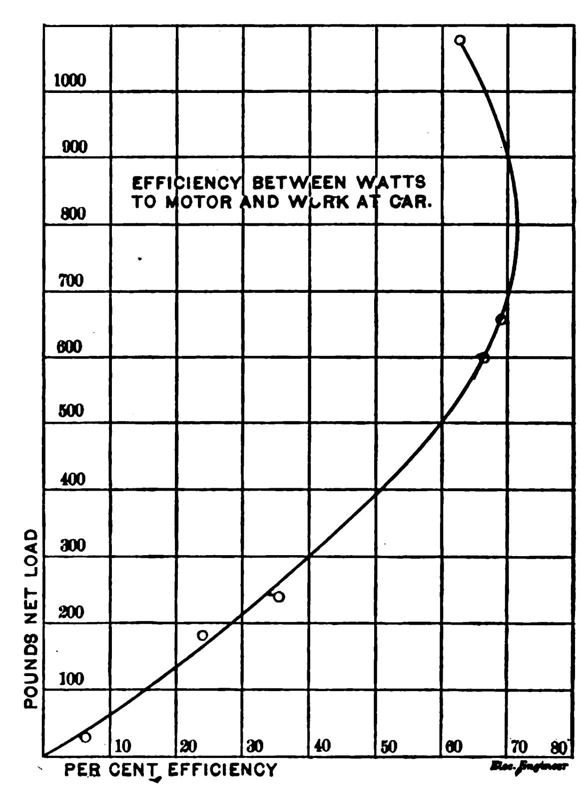


FIG. 5.

The following table shows the results of the engine tests in condensed form:

Test.	Average I. H. P. at engine.	Water per hour. per H. P.
1	10.98	43.7
3	10.78	38.9
4	11.09	38.2
5	14.14	41.65
6	12.83	39.9
Average	11.9	40.5

The average current supplied to the fields at 110 volts was 7.4 amperes, which, reduced to i. h. p., gives 1.35. This gives the following:

Total average I. H. P. per elevator	H. P.	13.25
Water per hour per elevator	lbs.	535.6
Coal per car mile per elevator	"	32.2
Cost per car mile per elevator	cts.	4.8
Kilowatt hours per car mile		2.70

The combined efficiency of motor and elevator gear or between watts delivered to motor and net weight lifted at car is shown as a curve in Fig. 5, the maximum efficiency observed being 69 per cent. The curve shows a probable maximum efficiency of 72 per cent at a load of 850 lbs. The combined efficiency of engine and dynamo under steady load at 13 horsepower was about 50 per cent.

Discussion of Results.—The relatively poor showing of the engine, 40.5 lbs. per hour per horse-power is accounted for by the fact that a 50 horse-power engine is called upon to work under a load varying from minus 10 horse-power to an occasional maximum for a few seconds of 33 horse-power, the average being, as given in the table, 12 horse-power.

The demand of the owner of the building was for entirely independent units. Had the plant been designed to run from one engine with a duplicate in case of breakdown better economy might have been attained. It seems probable that under these circumstances a 60 horse-power engine would have sufficed to operate the three elevators in the building, whereas three 50 horse-power engines are used. Even if separate units are retained the size could be much reduced.

There seems to be no data available showing the combined efficiency of an engine and dynamo under variable load, but if on one hand by reducing the size of the separate units the water consumption could be reduced to 35 lbs. per hour per horsepower and the efficiency be increased, say, to 60 per cent.—or, on the other hand, if by running from one engine the variations demanded by one car were to offset those of the others, thus raising the combined efficiency of engine and dynamo possibly to 70 per cent.—we should then have the following results:

	Separate units effi. 60 p. c.	1 eng. for 3 cars effi. 70 p. c.
Average horse-power per elevator	11 h. p.	9.5 h. p.
Water per hour per elevator	385.5 lbs.	331 lbs.
Water per car mile per elevator	209 "	183 "
Coal per car mile per elevator	23.2 "	19.9 "
Cost per car mile per elevator	3.46 cts.	2.97cts.
Kilowatt hours per car mile	2.70	2.70

The cost as given above includes the coal only, no addition being made for labor, interest, or repairs.

THE management of the Exposition Company have sent a letter to the E. S. Greeley & Co., extending to them their high appreciation and sincere thanks for the loan of the gold key, used by President Cleveland, in opening the World's Fair, at Chicago, in 1893, for use at the Exposition Building on Saturday evening, May 16, 1896, in transmitting the message from Dr. Chauncey M. Depew to Edward D. Adams, around the world.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST MILLENIUM EXHIBITION.—II.

BY ALFRED O. DUBSKY.

As the polyphase network of conductors is not extended over the whole exhibition—the three-phase plant not being large enough to supply all the electric power—there is a very large number of single-phase motors fed from the single-phase lighting central station of the city of Budapest. Besides, the polyphase central station of the exhibition works only in daytime, therefore the motors working in the evening and at night must be of a different type. The alternating current motors are either synchronous, or induction or asynchronous series motors.

The synchronous motors are all self exciting. Fig. 7 shows the winding diagram and the Blathy starting device employed for this type of motors. The motor has a stationary armature and revolving field magnets, and a commutator is fixed on the motor shaft. The black and white segments, Fig. 7 are well insulated from one another, but in electrical connection among themselves.

The diagram, Fig. 8, shows the arrangement of this motor. The armature and field magnet are in parallel on the same mains. Switching them on the mains an alternating current flows through armature and field; without any special device the armature would take a larger current than the field magnets, which latter have a larger self-induction. Moreover, with such a method the phase of the currents would be widely different in both windings, while for good starting it is required that current should be always exactly in phase in both parts of the motor. Therefore it will be quite advantageous to put a choking coil in the armature circuit on account of the difference of self-induction.

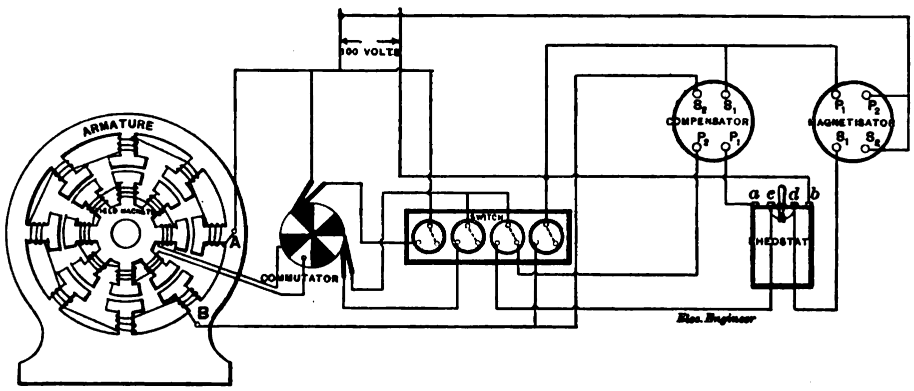


FIG. 7.—STARTING DEVICE FOR SYNCHRONOUS ALTERNATING MOTORS.

In order that a large alternating current may flow through the field magnets at starting, notwithstanding their large self-induction, the electromotive force applied at such times at the terminals should be four or five times greater than at full speed. For this purpose the full main tension is applied during the starting on the field magnets; but these latter are wound for a lower tension and at full speed, when the commutator is already at its regular work, a transformer supplies this low tension current from the main circuits.

The commutator has two brushes on each terminal. The passage of the brush from one segment to the other is made at the instant the alternating e. m. f. changes its sign; in regular work there would be a sparking disastrous to the commutator on account of the field self-induction. In order to prevent this, the field windings are short-circuited just a little before the alternatng e. m. f. changes its sign. The short-circuiting at this instant is made by the second brush; the current induced in this way in the field windings is of the same direction as the current circulating before. In this way the undulations are much equalized, the sparking is reduced and the magnetic field is more constant. The necessary connections for the starting are made by an ordinary two-throw switch. While starting, the connections are are shown by the dotted lines, Fig. 7. The current enters the armature at A; leaving it at B, the current flows through the choking coil, serving to increase the lag of the current. For this purpose the secondary winding S_2S_1 of a transformer is used. This is the "compensator" of Fig. 7. The current returns thence to the other main.

The field magnets are wound for low tension, 25 volts, for instance, and in regular work a special transformer or "magnetisator" furnishes the current from the principal mains. At the moment of starting this current is simple alternating current, and the field winding offers considerable inductance.

Therefore the 100 volts tension of the mains is increased by the primary winding of the "compensator," the secondary of which is in the armature circuit. This increased tension is applied at the terminal instead of the 25 volts in regular work at full speed. The "compensator" is, therefore, employed as a choking coil for armature current; at other times it serves as an ordinary transformer.

The field magnet circuit contains in the starting arrangement fixed resistance in order to diminish its inductance. In this way the phase of currents will be nearly the same in the armature and field magnet circuits. The current flowing from one main passes though this fixed resistance between a and b; the main

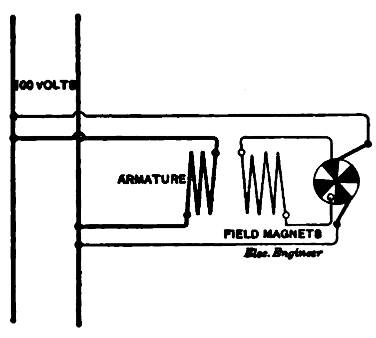


FIG. 8.

tension is then raised by P_1P_2, the primary of the "compensator," and this higher tension is on both brush terminals.

The motor will start with this device and will reach synchronism very quickly. At that instant the current in the revolving field magnets is already entirely commutated, though always very undulating. Connections are then changed by throwing the switch handle to the other side. The secondary winding of the "compensator" is short circuited and full pressure is on the terminals of the armature. The "magnetisator" is fed with current directly from both mains and its secondary low-tension current flows to the field winding. The resistance, c, b, in this secondary circuit is variable and regulates the intensity of this exciting current. The two brushes at each terminal

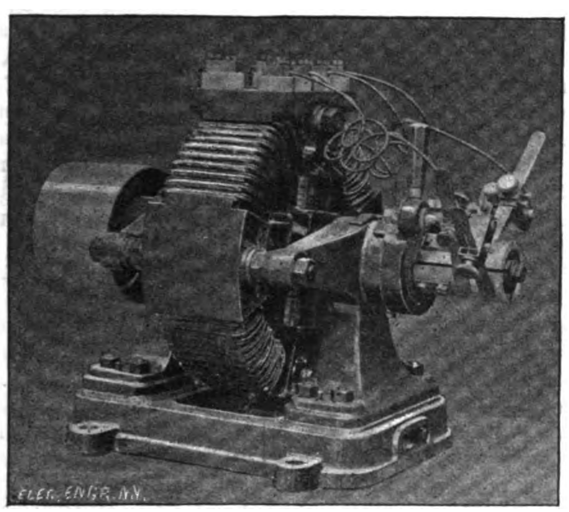


FIG. 9.—GANZ 3 H.-P. SINGLE-PHASE SYNCHRONOUS SELF-STARTING MOTOR.

are short-circuited in order to diminish the undulations of the alternating current. Sparking at starting is larger than at full speed, when there is almost no sparking, on account of the short-circuiting of the double brushes. Fig. 9 gives a view of one of these motors.

Induction Motors.—Single-phase induction motors have come into general use during the past few years, on account of the simplicity of their construction. They resemble greatly in their manner of operation and in their construction polyphase motors, but never attain all their advantages. Not only is their efficiency below that of a polyphase motor of the same size, but the starting requires also different artificial means, which are not necessary in polyphase work. Besides, the motor stops, if it is run much above its rated power.

Fig. 10 shows the winding diagram of a two-pole induction motor. The winding is divided into two separate parts, namely, I-III. and II-III. It is a regular two-phase winding and by sending two currents into them, which have, even approximately, a difference of phase of 90 degrees, the armature will revolve. In regular work, at full speed, a single-phase current between I. and II. will be sufficient to maintain the revolution of the armature.

At the moment of starting the currents are split by the use of resistances and choking coils. Let a and b, Fig. 11, be the secondary terminals of a transformer; c, the middle of this secondary winding is so connected that the potential between a and c is equal to that between c and b. If R is an ohmic re-

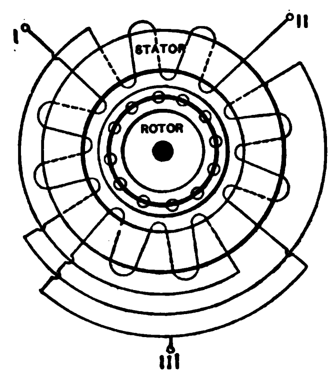


FIG. 10.

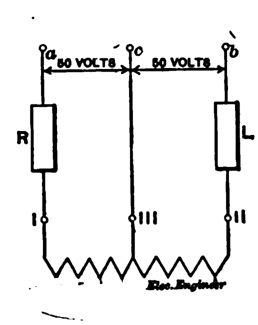


FIG. 11.

sistance and L the choking coil above mentioned, the motor will start if the connections are made as indicated. Both R and L must have a certain value determined by experience in order to split the phases in the proper degree. Starting can be effected only at no load, as the torque is not large enough to start with any load. At full speed a switch is thrown over; in this way R and L are cut out from the circuit and the motor can be loaded. Fig. 12 shows a view of one of these induction motors. The smaller motors up to 8 horse-power, as shown, have double pulleys. One pulley is keyed to the motor shaft, while the other is loose and is supported by a special outboard bearing. Both pulleys have a flat rim on the inside. While starting, the belt is on the loose pulley and the motor

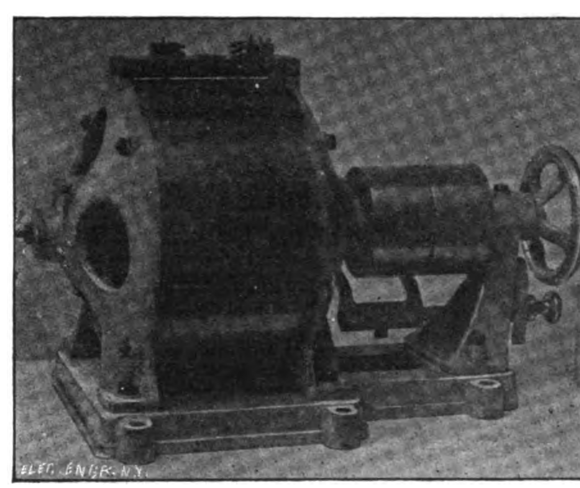


FIG. 12.—GANZ 3 H.-P. SINGLE-PHASE INDUCTION MOTOR.

can be started with the device described above. When full speed is attained the loose pulley is slowly pressed on the keyed pulley by turning the hand wheel on the outboard bearing. In pressing the loose pulley to the keyed one there is friction set up between the rims sufficient to transmit the speed of the keyed pulley to the loose one. When they are both revolving at full speed, the belt is thrown over to the keyed pulley. In this way the load is put slowly on these motors and not with a sudden jerk.

SMYRNA, DEL.—The Town Council has accepted the resignations of H. S. Anthony, Superintendent of the electric light and water plant, and George W. Rose, engineer of the electric light plant, and appointed a committee to solicit applications for the positions.

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CONTENTS.

GROWING REQUIREMENTS OF ELECTRIC TRACTION.

THE transition from animal power to electric power on almost all of the street railways in this country has taken place so rapidly that railway engineers have found it difficult in the absence of any precedents to keep pace with the additional requirements which are made necessary by the introduction of electric traction. In order to design and install a modern high-class electric railway system it is necessary to combine a considerable knowledge of electrical, mechanical and civil engineering, and in each of these branches the necessary knowledge has had to be acquired by experience growing out of early failures. In almost every detail of the system the size and strength of the various parts were greatly underestimated, owing no doubt to the much less rigorous requirements of horse roads, which were at first the only guide to street railway practice. It is interesting to notice the additions and changes which have gradually been brought about with advancing experience. Mr. Sprague started to equip his earliest motor cars with two 7½ horse-power motors each, and at first sight 15 horse-power would seem ample to replace the power of two horses, even with allowance for the additional weight of machinery on the car, but it was soon found necessary to double the capacity of the car motors, and later the standard car equipment was increased to two 25 horse-power motors, which is the capacity of most of the trolley cars in general use to-day.

The line-wiring is another matter which has undergone a very great change. At the start the return circuit through the tracks and the ground was considered not to offer any resistance, and the wiring was calculated as though the entire resistance of the circuit was that of the overhead line. As a result of this it was found that in a good many cases the station pressure of 500 volts was reduced to about 300 volts at the ends of long lines, and burn-outs of the machines were of almost daily occurrence. The resistance of the return circuit soon became a very apparent evil, and extra bonding and the addition of grounded wire to the tracks were increased gradually until the standard practice now is to supply a metallic return circuit of carrying capacity equal to that of the overhead lines. The same change of practice has been noticeable in regard to the size and strength of rails employed in street railway service. In the days of the old horse cars rails weighing from 30 to 40 pounds per yard were generally employed, and these were always laid on stringers. The tread of these flat rails was not more than from an inch to two inches deep, and the flange less than half an inch thick. With the grinding action of the trolley car wheels, and the greatly increased weight of the cars, the tread of these rails was soon worn so thin that the wheel flanges came in contact with the rail flange and pressed out all the rivets which held the bonds; so flat rails had to be entirely abandoned. Practice has been constantly increasing the weight of rails, which now generally run from 60 to 90 pounds per yard, and are always of the tee, or the girder pattern.

Another point is now being forced upon the attention of the owners of trolley roads, which is of the greatest importance, and that is, the subject of railway bridges. With the horse cars almost any bridge that would carry ordinary wagonloads was sufficient for the purposes of a street railway, but with the advent of the electric car with its greatly increased speed and weight a great many of the bridges formerly used became entirely inadequate for the new service. A writer in the "Railroad Gazette" points out the fact that bridge acci-

dents on trolley roads are beginning to be reported, there being no less than four during the past six months. The most disastrous of these occurred on May 26 last, at Victoria, B. C., by which forty-three lives were lost. Steam railroads have learned by long and often unfortunate experience that a bridge is the worst possible place to skimp on material, and most roads of any considerable size now employ their own experts to not only design all bridges on their lines, but to periodically examine them; but it is doubtful if any trolley car companies have taken this precaution yet. Such accidents, however, should draw the importance of this subject to the attention of those who are in any way responsible for such bridges. In building bridges for the use of trolley cars the tendency is to underestimate the loads which they will have to carry. It should be remembered that the average load is not the one which is liable to prove dangerous, but the adventitious loads which are liable to occur at any time. It is also inevitable that a car having a capacity of fifty passengers will at some time be loaded with perhaps 150 passengers, and it is for these exceptional cases that the bridges should be designed. If the fact is considered that there is very slight difference in the cost of a good bridge and that of a poor one there is very little excuse to be found for the failure of a bridge.

THE THREE WIRE PATENT IN ENGLAND.

THE efforts which have been made to extend important patents beyond their natural life in this country have been numerous. It appears that America, however, is not alone in this respect, as, now that the English three-wire patent of Dr. John Hopkinson is approaching its expiration, application was made to the Privy Council for an extension of the same, based principally on the ground that the inventor has not yet received adequate remuneration from this method of distribution. According to the story told in the petition for the renewal of the Hopkinson patent it appears that in spite of its large adoption by central stations and other plants which are using the system under license, the petitioners—the Westinghouse Electric Company, who control the patent—have lost considerable money in exploiting it. The patent was granted in the early days of electric lighting and for the first eight years of its life there was practically no opportunity to apply the invention, and prior to 1889 Dr. Hopkinson had succeeded in licensing only three stations in England from which a net profit of only $1,000 was derived. At this date the Westinghouse company acquired an interest in the patent, and, according to the figures submitted, their experience with it has been a costly one. They received in royalties the gross sum of $106,956 up to the close of the year 1895, which, after deducting the expenses incurred in the purchase of the patent rights, the payment of renewal fees, legal and other expenses up to the present time, leaves them a net loss of $36,235, not allowing any deduction for interest on the capital expended on the patent! It has also been the subject of considerable litigation, which has been long and costly.

Considerable objection was urged against any renewal of this patent by a number of municipal lighting corporations who are licensees of the Westinghouse company and who objected to paying any further royalties after the date of July 27, 1896, when the patent would naturally expire. The objection was also urged against its extension that the patent was acquired by the Westinghouse company as a trading speculation and not with any view of assisting the inventor, and even if the company had not received adequate remuneration from the patent, that afforded no ground on which an extension ought to be granted.

After a short hearing the Judicial Committee of the Privy Council rejected the plea of the owners of the patent, evidently taking the view put forward by the objectors that as Dr. Hopkinson had actually received $47,000 from the Westinghouse Company, it could not be held that the patentee himself had not been sufficiently rewarded. The three-wire system is, therefore, now public property in England, though it is still subject to the Edison patent in this country.

There is one phase of this litigation, however, which is well worth noting. The three-wire system is now in use by a considerable number of municipal plants in England, and it is also noticeable that the objections came, with one exception, from such plants. Many of the devices and details of construction in connection with electric light and power service are patented, and most of the important electrical patents both in Europe and America have been objects of infringement suits involving large sums of money both in legal expenses and in damages. Herein lies a difficulty which is liable to occur in the case of municipally-owned plants and which is worthy of consideration by the advocates of municipal ownership. As long as any electrical patents remain in litigation any municipality operating its own plant is liable to be put to heavy expense in the defense of infringement suits and may possibly be called upon to pay large sums in damages if infringement is proved. We have seen in this country electrical concerns obliged to suspend business owing to adverse patent decisions, and while private corporations are obliged to take risks of this character it would seem that they would hardly be voluntarily incurred by any municipality.

MUNICIPAL CONTROL OF ELECTRIC LIGHTING PLANTS.

THE communications which have reached us during the past few weeks indicate unmistakably the fact that information is still desired in many quarters on the pros and cons of municipal ownership of electric lighting plants. We have but recently printed Mr. Allen R. Foote's able paper showing the fallacies and ignorance displayed in many arguments advanced by advocates of municipal ownership, but, after all, we believe the best arguments are those which many existing municipal plants themselves afford for the opponents of the system. Probably the station most discussed of any city plant in the United States is that situated in Detroit, which has now been in operation one year, and the first annual report of which is before us. According to this report, it costs the city of Detroit $84.70 per year to operate each lamp. This figure, however, does not include any allowance for sinking fund, depreciation or loss of taxes, etc. We have it on no less an authority than Mr. Alexander Dow, late electrical engineer of the Detroit city plant, that, making due allowance for all these items, the cost per lamp would practically be $100 per annum. Mr. Dow, who ought to be well acquainted with the conditions, admits that Detroit was an exceptional case, both in the condition of its local lighting companies, and in its arrangements as a municipality, and the circumstances which led to the establishment of a municipal plant at Detroit may never be duplicated in the experience of another city, and that conditions equally favorable to non-political management exist in few cities of its size. If, therefore, with such ideal conditions the cost per lamp is not less than $100 per annum, we scarcely see what benefit can be gained by cities installing their own plants, when many cases could be cited in which the rates charged by private companies are no greater and in some cases even less than those quoted above. In order to bring home still further the argument, we print in this issue an excellent series of facts and figures prepared by Mr. W. W. Bean for the benefit of the taxpayers of St. Joseph, Mich., which ought to convince any one who is open to conviction in the matter. It is gratifying, indeed, to know that light is at last beginning to dawn on some who have been carried away by the allurements of city lighting plants; thus Grand Haven, Mich., by a large majority recently rejected the proposition to issue bonds for the purchase of an electric light plant, and the voters of Pontiac, Mich., rejected the proposition to issue $9,500 in bonds to pay the expenses of themunicipal electric light and water works plant.

ELECTRIC TRANSPORTATION.

THE CLARET-VUILLEUMIER ELECTRIC RAILWAY, NEAR PARIS.

In the early part of June, the Claret-Vuilleumier Street Railway was opened and is now in regular operation on the surface contact system. The power house, a part of which is shown in Fig. 1, is situated at Lilas, near Paris, France. It contains three semi-tubular boilers which operate the three Garnier-Corliss engines, shown in the illustration. These are of a capacity of 200 horse-power each at 85 revolutions per minute. The cylinders are mounted in tandem and the engines are run condensing. They are belted each to a Hillairet four-pole,

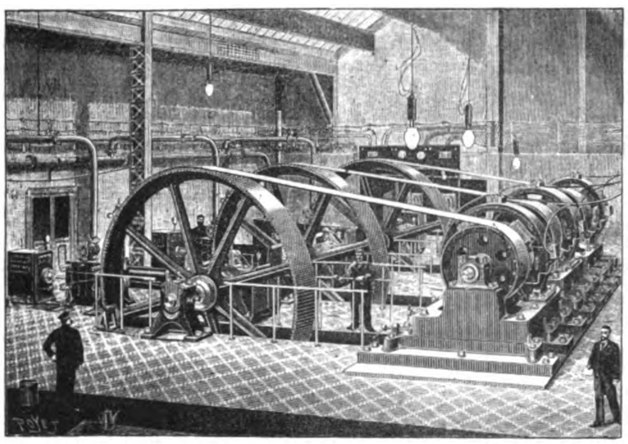


FIG. 1.—VIEW OF POWER STATION, CLARET-VUILLEUMIER RAILWAY SYSTEM, PARIS.

compound wound dynamo running at 300 revolutions per minute.

The three dynamos are connected to the switchboard, shown at the rear in the illustration, each dynamo being first led to a switch at the center of the board, where it may be connected to either the railway circuit or to an entirely independent lighting service which the station also supplies. In the evening one machine supplies the lighting, while the other two operate the railroad.

The road is partly single and partly double track and one lead from the dynamo is connected directly to the track. The other line from the dynamo is a lead-covered cable, which is laid directly in the ground beneath the sidewalks, and to this cable the distribution boxes are connected. These boxes are situated

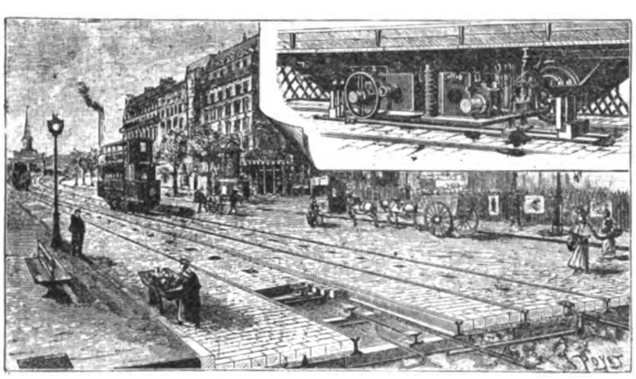


FIG. 2.—VIEW SHOWING CONSTRUCTION OF CLARET-VUILLEUMIER RAILWAY SYSTEM.

100 metres apart and are of cast-iron, each having two covers. A distributor situated in each box is in the shape of an arc of a circle upon the periphery of which twenty metallic contacts are placed. Each of these contacts is provided with a cable connecting the distributor to a copper wire, which unites two adjacent surface contacts. This network of cables is shown in Fig. 2. On the sidewalk to the left is an iron box which encloses a distributor; a wire leads out from this box and it is shown further on at the place where it joins the connecting wire between two contact blocks. These blocks are made in two parts, an upper and a lower piece connected by a vertical web. They are insulated from the earth by a mixture composed of pitch and bitumen which provides sufficient insulation. The wire running between them is insulated in the same manner. The blocks are set in the pavement so that they only project above the surface of the ground about 5 mm. It is evident from what has been said that each distributor will be able to feed twenty successive contacts along the road.

Fig. 3 shows the details of the distributor. Against the metallic plates appropriate brushes make contact and these are carried on a central arm which is in electrical connection with the station. The movement of this arm is secured by means of two electro-magnets, F and G, one for the forward and the other for the backward direction. Both become active at the moment the car arrives at a contact block. A diametrical bar carrying the contacts is drawn by an electromagnet against a pawl held by a spring. This pawl fits in the notch of a toothed wheel which forms part of a train which moves the arm along the plates, A, B, C, etc., and establishes an electrical connection to the surface contact boxes. The movement of the arm is continued successively as the car passes each contact.

In order to pass from one distributor to the next the two last plates of the first distributor are connected to the first two plates of the following distributor. Two suitable contact bars are carried on the bottom of the car to make contact with

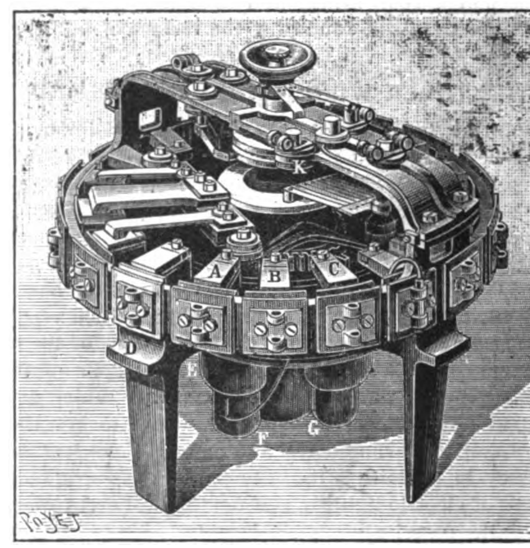


FIG. 3.—THE AUTOMATIC DISTRIBUTOR.

the metal blocks from which they receive the current. The cars are also provided with two Hillairet motors each.—"La Nature."

THE WORK EXPENDED IN BICYCLE PROPULSION.

As frequent attempts have been made to drive bicycles by electric power from storage batteries carried on the wheel, some recent experiments of the power consumed, made by Mr. Bouny, will be of interest to workers in this field. Mr. Bouny shows that there is no absolute dead point such as occurs with an ordinary connecting rod and crank motion, and, secondly, that there is always some pressure on the pedal during the rise, the negative work due to which has to be subtracted from that done during the down stroke to obtain the net amount used in propulsion. The experiments were made at speeds ranging from 10⅝ to 21¼ miles per hour, the machine being run on a wooden racing track. The results were as follows:

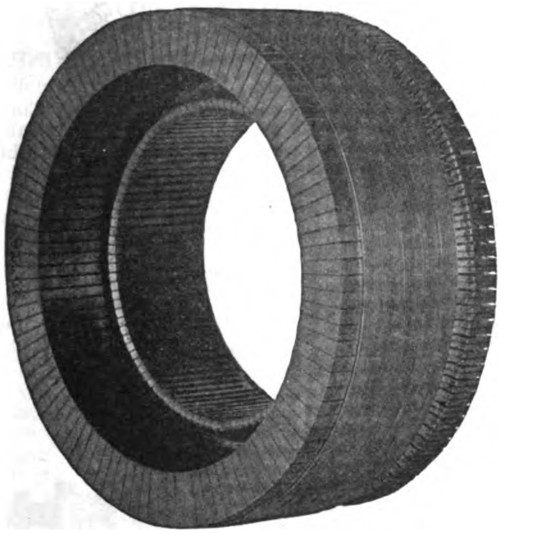
Speed. Miles per Hour.	Work Done per Semi-Revolution. Ft. lb.
10	18.58
10⅝	20.96
12.5	33.98
15.0	47.50
17.5	56.75
20.0	63.62
21¼	66.08

It will be seen from the above figures that the average pressure of the foot required on the pedal increases rapidly with the speed, being at 20 miles an hour nearly 3½ times as much as at 10 miles per hour. Unfortunately the gear used is not noted by M. Bouny, and so it is impossible to deduce from the

above figures the average tractive resistance of the machine at the different speeds. Probably at the higher speeds named a large proportion of the total work done was expended in overcoming atmospheric resistance, and the run of the figures might be changed considerably if the trials were conducted on a rough road instead of on a smooth track.

NEW G. E. 800 RAILWAY COMMUTATOR.

The maintenance of the quality of a railway motor depends to a large extent upon the accuracy with which those parts which are subject to wear can be replaced to render the motor as perfect as when new. In refilling the commutator, for instance, considerable difficulty is usually experienced on account of the necessity for great accuracy in turning the segments to fit the cones of the shell, which cannot readily be done unless special tools are employed. To obviate this difficulty the General Electric Company have devised complete sets of segments and segment insulations for all types of railway motors, securely bound together by a band of wire to prevent



New G. E. 800 Railway Motor Commutator.

movement and finished ready for assembly on the old shell. In addition to the preparation of the cone fits, the segments are slotted and tinned for the reception of the armature leads. The only work necessary in the shops is to screw together the cap and shell clamping rings, to solder in the leads and to true off the face of the commutator. Practically all the machine work formerly done at the operating company's shops is eliminated and as the segments are clamped together by hydraulic pressure, they are much firmer than those usually manufactured on the premises of street railway companies.

Hard rolled copper only is used for these segments and to give a longer life to the commutator, the depth to which the segments can be turned has been increased by 40 per cent.

BICYCLE CARS NOT WELL PATRONIZED.

The experiment of running cars for the accommodation of wheelmen, which the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., began about three weeks ago, has not been as successful as was expected, according to General Manager Weeks. Bicyclists are allowed to check their wheels without the payment of an extra fare. It was believed that many wheelmen would take advantage of the opportunity to get rid of the roughest and most unpleasant part of their suburban trips. The objections to the bicycle cars apparently are the delay in getting a wheel checked and waiting for the cars. The service will be continued, and an attempt will be made to improve it and to make it more satisfactory to the wheelmen. Then, if it is not better patronized, it will be discontinued.

STRINGING LIVE TROLLEY WIRE.

A system for the rapid stringing of trolley wires has been devised and applied on the lines of Sioux City. The reel containing the wire is placed on the platform of a car, so that it may revolve and put a tension on the wire. From here the wire passes over a wheel on the roof, where the men standing on an insulated platform can readily attach it to the supports. What is most novel about the system is that the wire that is thus strung supplies the current for the propulsion of the car, and is, consequently, a "live" wire, the current supplying power to the motors constantly passing through it.

AN UNDERGROUND ELECTRIC RAILWAY FOR BRUSSELS.

The electric underground road has earned such golden opinions in London that the Belgians are turning their attention to the system for their city passenger traffic. A railway, based on the Greathead system of tunnels, is now proposed for Brussels. It is to be worked by electricity and to run 50 feet below the surface. The first portion is to consist of a complete circle about four miles long, with double track, having eleven stations, and a future extension of a second circle of about two miles long, with four stations; the two tunnels for the different directions will be quite distinct from each other; they run almost entirely below the public streets. The subsoil appears to be clay. There is to be a two and a half minute service each way. The total cost of the first circle is estimated at $3,000,000, a less rate than the City and South London line, which cost $1,000,000 per mile. The elevators are to be operated by hydraulic power, and will hold forty people.

TELEPHONY AND TELEGRAPHY.

TELEPHONE EXPERIMENTS IN BRUSSELS.

The Belgian authorities have recently made some interesting experiments with the loud-speaking telephone instrument and electrical firm-alarm appliances of the Single Wire Multiple Telephone Signal Company, of London. In addition to the apparatus to test the adaptability of which the experiments were arranged, a new portable loud-speaking combined telephone and telegraph instrument, specially designed for military purposes in the field during operations, formed a feature of interest, the extreme portability and light weight of the whole apparatus attracting considerable attention. It was proved that although the wires connecting the instrument were cut, Morse signals were quite audible even when several feet of damped twine were interposed in the circuit. We understand that the British military authorities are taking an interest in the instrument, and that a demonstration of its special suitability for military purposes will shortly be given.

UNDERGROUND TELEPHONE WIRES IN BALTIMORE.

Mayor Hooper has signed the ordinance authorizing the Home Telephone Company to lay its wires and cables in unused conduits of the Police and Fire Alarm Telegraph's subway system, and to erect poles for temporary use in sections of the city to which the subway system does not yet extend.

Under the ordinance the company is required to pay the city as rental 7 cents a year for every linear foot of duct occupied by its lines. This rental must be paid semi-annually. Should the company be in arrears for three months, the Mayor is authorized to have the lines removed at the company's expense. Within two years the company is required to have no less than 2,000 telephones in actual service.

JAPANESE TELEPHONE ENGINEERS INSPECTING OUR SYSTEM.

Mr. Okomoto, Engineer of the Ministry of Communication of Japan, visited Brooklyn, N. Y., recently and spent a long time at the headquarters of the Telephone Exchange, on Smith street, where he studied the switchboards and the underground system. He was also shown how the wires were strung on the elevated railroad structures and also placed under ground in the subways. He said it was the intention to extend the telephone system over the entire Empire of Japan. A long-distance line was now being constructed, he said, from Tokio to Kobi, a distance of 350 miles. There are no underground subways in Japan, and the wires are stretched from place to place by means of poles. Mr. Okomoto expects to visit all the larger cities, and return home by way of San Francisco in September.

THE DETROIT TELEPHONE CO.

The subscription lists of this new telephone company have reached 4,000 names, of which nearly 3,000 have signed three year contracts. It is claimed that the cost of a plant for 5,000 telephones will not exceed $600,000. If this includes instruments, switchboards, real estate, underground distribution, etc., it is a phenomenally low figure.

LITERATURE.

THE MAGNETIC CIRCUIT IN THEORY AND PRACTICE. By Dr. H. Du Bois. Translated from the German by Dr. E. Atkinson. New York, 1896. Longmans, Green & Co., 360 pp. 5½ x 8½ in. 94 illustrations. Price, $4.

The plan of this work arose out of a lecture delivered by the author on the occasion of the International Congress of Electricians at Frankfort in 1891, and the book fulfills the desire from many sources for a systematic and critical account of the most important developments in the direction of magnetism. The historical side of the subject is touched upon but lightly, and the author has chiefly directed his efforts to describing the actual state of theoretical and experimental inquiry. The book is formed of two parts, Part I. pertaining to theory and Part II. to applications of magnetism. The two introductory chapters are as elementary as the nature of the work will permit and deal with the mathematical theory of the electromagnetic field. Chapter III. summarizes the theories of the "rigid" magnets on one hand, and of absolutely "soft" cores on the other. In Chapter IV. the theory of magnetic induction is outlined and a few special cases of magnetic induction are considered. The author states what is obviously true, that we are still a long way from determining the general problem of induction, namely, to determine completely the magnetization of a body of arbitrary shape when the inducing field is distributed in any manner whatever.

Part I. closes with a chapter on the theory and experimental tests of the magnetization of closed and of radially divided toroids or rings of circular section. Kirchhoff was the first to investigate mathematically the magnetization of a ring of either rectangular or circular section and subsequent investigations of Professor Stoletow and Professor Rowland have up to the present time given us no reason to doubt the correctness of Kirchhoff's theory. The experimental tests include the investigation of the iron toroid by H. Lehmann, whose experiments were conducted with the object of testing the author's theory of the magnetization of a radially divided toroid, and with the result that the theory here developed was confirmed by the experiments with sufficient accuracy for most purposes.

The second part of this work commences with a study of the general properties of the magnetic circuit, and this treatment of the subject is from the standpoint of applied physics. This part of the work relates to the application of the principles developed in the early part of the book to the machines and apparatus used in actual practice or in the laboratory. A chapter follows, which is devoted to the analogy of the magnetic circuit with other circuits. Maxwell first noticed that the problem of induced magnetism when considered with respect to the relation between magnetic induction and magnetic force corresponds exactly with the problem of the conduction of electric currents through heterogeneous media, and later Lord Kelvin in his theory of magnetism has frequently dwelt on the complete analogy existing between the mathematical theories of magnetic induction, of dielectric polarization, and of Fourier's theory of thermal conduction on the one hand, and the theory of a number of hydrokinetic processes on the other.

The purely practical part of the book commences with Chapter VIII., on the magnetic circuit of dynamos and electromotors, and includes the experimental determinations of leakage, calculation of air reluctances, armature reaction and multiple magnetic circuits. This is followed by a chapter on the circuits of various electromagnets and transformers and the book concludes with two chapters on experimental methods of measurements of magnetization and of induction. The book will be found of great value to the advanced student in electricity.

SOMETHING ABOUT X-RAYS FOR EVERYBODY.—By Edward Trevert. Lynn, 1896. Bubier Publishing Co. 75 pp., 5 x 6½ in. 42 illustrations. Price, 25 cents.

This little book is a compilation of odds and ends in regard to Röntgen rays intended for the general reader, and is not in any respect a technical work. It commences with a detail description of the manner of manufacturing an induction coil, giving dimensions, sizes of windings, patterns of vibrator, etc. A number of different shapes of Crookes tubes are described and the manner of connecting up the apparatus for taking shadow pictures is shown. The remainder of the work is devoted chiefly to illustrations and descriptions of Röntgen photographs which have appeared in the technical and daily press.

A THEORY OF THE STRUCTURE OF NATURE.—By James S. Alden, M. E., Passaic, N. J., 1896. Published by the author, 48 pp., 5½ x 9 in., paper. Price, 50 cents.

The author's theory of the structure of matter is premised by the assumption that an atom of matter consists of a vortex ring of luminiferous ether, and this theory is elaborated by a study of the mechanical effects which such vortex rings would produce, and the comparison of such effects with the known phenomena of matter.

The author starts with the assumption that "an elementary atom cannot exist without all of its vortex rings in combination," and shows how the movements and vibrations of these vortex rings might produce the phenomena of gravity, electrostatic attraction and repulsion, heat, light, electricity, and, in fact, all the physical characteristics of matter with which we are familiar.

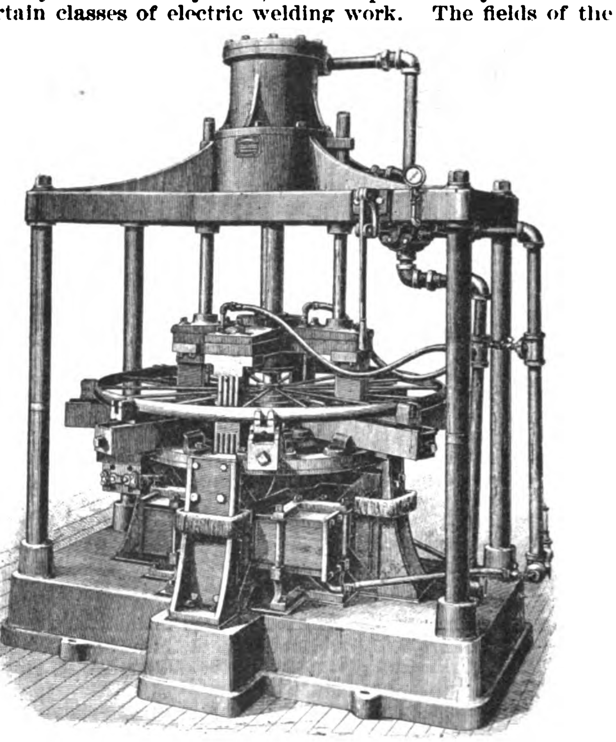
The subject matter of this pamphlet is entirely hypothetical, and the arguments are based purely on mathematical deductions. The author closes with a short appendix in which he attempts to trace an analogy between the structure of matter and the structure of the spirit. In conclusion he states "the combined teachings of the Bible and science seem to indicate that faith and ether are one and the same thing." The appendix could have been omitted to the advantage of the work.

MISCELLANEOUS.

ELECTRIC WHEEL WELDING MACHINE.

The accompanying engraving represents an electric welding machine built by the Thomson Electric Welding Company of Lynn, Mass., especially for the Niles & Scott Company, of La Porte, Ind. It is intended particularly for making wheels having metal hubs and spokes, the parts being welded together by means of electricity. The machine was designed by Herman Lemp, electrician for the Thomson Company, and combines many novel and extremely interesting mechanical and electrical features.

Electricity is supplied by an 80-kilowatt alternating current, separately excited dynamo, built particularly for use in certain classes of electric welding work. The fields of the



ELECTRIC WHEEL WELDING MACHINE.

dynamo are excited by a 6 D Thomson-Houston type dynamo, 110 volts. The speed of the dynamo is 1,000 revolutions per minute, giving 50 cycles per second. The potential of the dynamo is governed directly by a rheostat in circuit with the field, which is manipulated by the operator of the welding machine, varying the potential according to the cross section of the work to be welded. The maximum difference of potential is 350 volts. The dynamo is of extremely rigid construction, large heavy bearings of the self-oiling type, laminated iron pole pieces and the ordinary tooth type armature.

The electrical part of the welding machine consists of four 20-kilowatt transformers, connected in multiple, which form, together with the magnets, the bottom part, as clearly shown in the engraving. These are surmounted by a brass ring supporting the various chucks for holding the wheel central with

the hub. It may be added that this centering device, as the machine is used to-day, has been removed, as it was not found necessary to have it, the center readily adjusting itself. The secondary of the transformer is separable. On top of the machine is a hydraulic cylinder, through the piston rod of which the necessary pressure is transmitted to the parts being welded. By means of the hydraulic apparatus the upper section of the secondary circuit is raised entirely clear and the parts to be welded are placed in the center of the machine. The secondary circuit is then closed and brought down so that the upper half of the circuit rests upon the top flange of the hub to be welded, the bottom resting on the lower part or section of the secondary circuit. The secondary circuit is made operative by means of sliding contacts. The primary circuit is then closed, and at once the two sections of metal forming the hub, by means of the pressure brought by the cylinder, begin to weld. The current is then kept on until such time as the entire outside diameter of the metal flanges together with the spokes which the flanges inclose is brought up to a welding heat, at which time the water pressure is again applied and the two parts of the hub pressed together at a welding heat. The time varies from fifteen seconds to two minutes, according to the cross section of the stock to be welded. The secondary current varies from 10,000 to 30,000 amperes, according as the cross section of the stock to be welded increases or decreases.—"Iron Age."

A ONE-VOLT STANDARD CELL.

BY W. AIBBERT.

FOR the last two years, the writer has been trying, with the Electrique," from which the following points are gath- volt cell as a standard potential difference. The original stimulus in that direction was partly sentimental, arising from the frequency with which students asked why the nominal standard volt was not actually on sale, in the same way as the standard ohms. Other reasons, however, were not wanting, and I determined to test the merits of a cell which was first designed by Helmholtz for other purposes.

The general construction of the cell is easily explained. It is in most respects like the Latimer Clark cell now used, with the substitution of chlorides for sulphates. Thus, the active metals are zinc and mercury, the liquid is a solution of chloride of zinc, and the paste is made with mercurous chloride. A diaphragm is required, and the details of this are of some importance.

The voltage of the cell depends chiefly on the proportion of zinc chloride that the liquid contains. The density required for one volt, is always near 1.380, but impurities are of considerable importance. The temperature coefficient is less than 0.0002 volt per 1 deg. C. This means such a small variation for ordinary temperature changes that it can be neglected. A thermometer is unnecessary, even though there is a certain lag of voltage behind temperature.

We have tested our cells at temperatures as high as 35 deg., a week's work under these conditions producing no detectable changes. We have notes of cells running over the best part of two years, showing a constancy as good as can be wished, so that there seems every ground for confidence that the cell may take a lasting position, and claim to be an improvement on the Latimer Clark.

ELECTROCHEMICAL ACTINOMETRY.

MR. MARECHAL has published an article in "L'Eclairage Electrique," from which the following points are gathered:

The apparatus described is designed to measure the electrical energy resulting from the impingement of light upon a copper plate covered with a thin film of oxide and opposed to a second plate with a clean metallic surface. Both plates dip into a solution of a haloid salt of an alkali metal, and the non-oxidized plate is protected from light by a suitable envelope. The electrolyte should be dilute, e. g., it should contain about 1 gramme of the salt per litre. On connecting the electrodes with a sensitive galvanometer it is found that the potential difference between the plates responds to small variations in the lights falling on that which is exposed, and that the plate with the film of oxide is always positive to the plate with a clean surface. Diffused daylight gives a reading of some thousandths of a volt, and direct sunlight one of nearly 0.1 volt.

The author has observed that for comparatively weak sources of light (taking daylight as a standard), e. g., the oxy-hydrogen light, the voltage is inversely proportional to the square of the distance of the source of light, i. e., it is proportional to the intensity of the light; with sunlight, on the other hand, the voltage lags behind the light intensity. Using monochromatic light it is found that the voltage is much influenced by the wave length of the impinging ray. Using sodium chloride or bromide as the electrolyte, the effect increases from the red end of the spectrum, gradually to a maximum at the green or green-blue portion; with sodium iodide the maximum voltage ranges from the yellow to the green-blue. Blue rays give only a feeble result, and the violet almost none. By promoting selective absorption the sensitiveness of the arrangement can be greatly increased. For this purpose it suffices to dip the oxidized copper plate in a weak solution of some coloring matter. Thus, using the dyestuff known as "crystal green" the sensitiveness of the couple is increased three or fourfold, while, with "malachite green," the increase is some eight times the original value. In this case the sensibility of the plate is naturally greatest for red rays.

It appears that in all the cases quoted the light does not act by virtue of accompanying heat radiations nor by its so-called chemical rays of the violet and ultra-violet, but by what Maréchal dubs its "actinicity." The reaction brought about by the impinging light may be simply represented thus:

$$4CuO + 2NaI + H_2O = 2NaOH + CuI_2.3CuO.$$

Numerous uses for the actinometer are suggested. It may be employed for the direct electrical registration of optical signals. It is also proposed as a photometer.

ELECTRICAL RESISTIVITY OF BISMUTH.

PROFESSORS DEWAR AND FLEMING recently communicated to the Royal Institution the following:

"In continuing our experiments on the electrical resistance of bismuth at low temperatures and in magnetic fields by the aid of a powerful electromagnet kindly lent to us by Sir David Salomons, we have observed the fact that a wire of electrolytic bismuth, when cooled in liquid air to a temperature of —186° C., has its resistance increased more than forty-two times, if it is at the same time transversely magnetized in a field of 14,000 units. The bismuth, when cooled in liquid air and thus magnetized, has its electrical resistance increased more than fifteen times, even when compared with its resistance at ordinary temperature (19° C.) and not in a magnetic field. There is no reason to believe we have reached the limits of this increase. We reserve further details for a full communication to the Royal Society later."

Supplementing this letter Professor Fleming writes as follows:

"It may be interesting to give the exact figures of observation: A bismuth wire was used having a resistance of 1.46 ohms at 19° C. when not in a magnetic field. If placed transversely to the field, in a field having a strength of 14,150 C. G. S. units, its resistance was increased to 2.34 ohms at 19° C. or 1.6 times. This, of course, is a well-known effect. If the same wire, however, was placed in liquid air and cooled to—186° C. its resistance fell to 0.53 ohm. If then placed transversely to the field in a field of 14,150 units, its resistance immediately increased to 22.4 ohms, or 42.2 times. Hence the bismuth cooled to —186° C. and in the field of 14,150 has a resistance 15.3 times greater than when at 19° C. and not in the field. There is a certain value of the field which just neutralizes the diminishing effect of the cooling on the bismuth resistance and leaves the wire when cooled in liquid air, and in the field, of the same resistance as when not cooled and not in the field."

A DANGEROUS PROTECTOR.

Our French contemporary, "La Vie Scientifique," in a recent number, illustrates and describes an apparatus which has been devised by M. P. Woog, with the object of protecting a lineman from the effect of a premature switching on of the current while he is working on a high tension single line circuit. The device consists of an arrangement for making contact between one end of a flexible wire and the line wire, either on both sides of the point at which the man is working, or on the machine side thereof only, the other end of the flexible wire being connected to earth. There is no doubt that if the line wire is properly earthed the lineman will be protected, although the machine may suffer unless it also is protected by an effective fuse or other cut-out; but everything depends upon the resistance to earth being sufficiently low.

PASSAGE OF ELECTRICITY THROUGH GASES.

Experiments by Otto Lehman are described in the "Zeit. Physical. Chem.," vol. 18, p. 97, in regard to the electric discharge through various gases, vacuum tubes, mixed gases with different forms of electrodes, and the discharge in a strong magnetic field. Illustrations of a large number of discharge phenomena are shown, and the author concludes that the views of Goldstein and Hertz, viz., that the discharge takes place into the ether and not into the gas, are erroneous.

RELATIVE COST OF IRON AND COPPER AS CONDUCTORS.

The accompanying table, given by Mr. J. R. Allen in "The Technic," shows the relative cost of copper in cents per pound as compared with wrought iron, Bessemer steel and cast iron in dollars per ton. The comparison is made for conductors having equivalent carrying capacity. In using Bessemer steel rails for conductors it is possible to use those that are winding

Cost of copper, in cents per lb.	Cost of equivalent wrought iron conductor in dollars per ton.	Cost of equivalent Bessemer steel conductor, in dollars per ton.	Cost of equivalent cast iron conductor, in dollars per ton.
7.	19.25	18.10	14.50
7.5	20.75	19.50	15.50
8.	21.50	20.30	16.75
8.5	23.75	22.25	17.75
9.	25.00	23.50	19.00
9.5	26.50	25.00	20.00
10.	28.00	26.25	21.00
10.5	29.25	27.50	22.00
11.	30.75	29.00	23.00
11.5	32.25	30.25	24.25
12.	33.50	31.75	25.25
12.5	35.00	33.00	26.25
13.	36.50	34.50	27.25
13.5	38.00	35.75	28.50

and imperfect. Such rails may be purchased at a greatly reduced price. Let us consider the saving that can be made by the use of Bessemer rails, assuming the rails to cost $25 per ton, as compared with copper at 11 cents per pound. Let the current to be transmitted be 1,000 amperes at 500 volts and the distance it is to be transmitted be three miles with 5 per cent. drop in voltage.

Cost of copper conductors	$39,000
Cost of Bessemer steel conductors	23,711
Difference	$5,289
Deducting $400 per mile for bonding	1,200
Total saving	$4,089
Saving per mile	1,363

The first use of steel rails as conductors was on the intramural road at the World's Fair. The Metropolitan Elevated Road, of Chicago, has also adopted steel rails as conductors.

TO RESTORE OIL WELLS BY ELECTRICITY.

An invention is about to be put on the market which, it is claimed, will start the dry wells running as freely as when they were first sunk. This invention is the work of a Washington gentleman, Mr. Tapley W. Young, and consists of an electric heater, which can be lowered into the well.

To understand the principles upon which this invention is founded, it will be necessary to explain that the theories as to exhaustion of so many wells is that the oil, in passing upward through the stone, has clogged the porous stone with paraffin in such quantities that the further flow is stopped and the well ceases to produce. Some think that it is because the supply in the earth has given out, but the generally accepted idea is that the oil is still in abundance, and only ceases to flow when the exit is stopped.

The stone through which the oil passes is of a very porous nature, and as the liquid is in a crude state, the thick matter becomes as dregs, settling in the rock near the edges of the bottom of the well. It has been common to use torpedoes to shatter the stone at the bottom of the well, thus breaking up the clogged matter, but this is an expensive process.

By the Young method the machine, which is about 3 feet long and resembles an iron cartridge, is placed at the bottom of the well, and the current turned on so that it receives just enough current to produce an enormous heat without melting the metal. By the peculiar construction of the carbon-packed chambers the intense heat is radiated about into the rock in all directions. Thus the paraffin and other refuse are softened and melted up so that they run, and when the well is started a fresh flow takes place, just as strong as it did when the well was first sunk.

THE SEYMOUR MANUFACTURING COMPANY, of Seymour, Conn., are enlarging their boiler house, and the new portion of the building will be constructed entirely of steel in order to make it absolutely fireproof. The contract for the steel work has been let to the Berlin Iron Bridge Company.

MARRIED.

DR. FREDERICK BEDELL was married to Miss Mary Louise Crehore, in London, on Wednesday, July 1.

PERSONAL.

MR. T. C. MARTIN, by special invitation, repeated his Niagara lecture, recently delivered at the Royal Institution in London, before the Société Internationale des Electriciens, in Paris, on July 8. Mr. Martin was ably assisted by M. Hillairet.

MR. JOHN W. LIEB, JR., has been appointed general manager of the Edison Electric Illuminating Company of New York.

MR. HENRY B. CRAM.

It is with feelings of regret that we have to announce the resignation of Mr. Henry B. Cram from the position of treasurer of the Bernstein Electric Company, of Boston, a post which he has filled for so many years with ability and conscientiousness. Mr. Cram is one of the old timers in the electrical business, and his name and that of the Bernstein Company have got to be considered almost as synonymous. His headquarters have for the past eight or ten years been at 620 Atlantic avenue, Boston, and most electrical visitors to that city never failed to run into the pleasant suite of offices on the first floor, and were always sure of a cordial welcome. One might say that Mr. Cram has grown up in the incandescent lamp business, and has followed all its varying conditions with the most absorbed interest, and has indeed made the study of the lamp situation his life work. Unassuming in manner and never at any time coveting publicity, Mr. Cram has yet made for himself in the electrical profession hosts of warm friends, who will all join with us in expressing the hope that he may soon find another sphere of usefulness, where his great experience in the electrical business must be of value.

OBITUARY.

ABRAHAM L. BOGART.

We regret to announce the death of Abraham L. Bogart, who died at his home in Jamaica, L. I., on Saturday, July 25, aged 80, years. He was the senior member of the firm of A. L. Bogart & Co., of this city, and was the inventor of numerous devices for electric gas lighting.

EDWARD A. ECKERT.

Edward A. Eckert, brother of General Thomas T. Eckert, president of the Western Union, died on Sunday, July 26, at the Commercial Hotel, Asbury Park, of heart disease. Three weeks ago Mr. Eckert was injured in a bicycle accident at Allaire, but had almost recovered from it. His physician, who was with him when he died, does not connect the death with the accident. Mr. Eckert was superintendent of exchanges of the Metropolitan Telegraph and Telephone Company, of New York.

JOHN N. GAMEWELL.

John N. Gamewell, inventor of the Gamewell fire alarm system, which is in use all over the United States, died at his home in Hackensack, N. J., on July 19, after an illness of three weeks. He was born in South Carolina seventy-three years ago, and during the war was superintendent of a powder mill in Columbia, S. C. Mr. Gamewell had lived in Hackensack 35 years. He made a fortune from his invention, but met reverses a few years ago in a railroad speculation. He leaves a widow and five children. His only son, the Rev. Frank Gamewell, is a missionary in China.

WALTER O. LEWIS.

The death is announced of Walter O. Lewis, for many years manager of the New York Ship News Office. He was one of the early advocates of the feasibility of the Atlantic cable, and was a warm friend of Cyrus W. Field. Mr. Lewis was the organizer of the Ship News Office for the old Associated Press. When the Boston and New York Telegraph Company was organized he was one of the managers. It was greatly owing to his industry and intelligence that the company was put upon a paying basis. He was about eighty-two years of age at the time of his death.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Biographical:

SIR JOHN PENDER.—Obituary with a complete review of his life.—London "Elec.," July 10, 1896. "Elec. Engr.," July 15, 1896.

Electro Therapeutics, Diagnosis, Etc:

NOTES ON ELECTRO-THERAPEUTICS.—By Drs. G. Gautier and J. Larat.—"Journ. of Electro. Ther.," July, 1896.

A NEW METHOD OF DILATING WITH FARADISM.—By Jennie W. Martine, M. D.—"Journ. of Electro Ther.," July, 1896.

ELECTRICITY AS A MEANS OF DIAGNOSIS IN GYNECOLOGY.—By G. Apostoli, M. D.—"Journ. of Electro Ther.," July, 1896.

ELECTRICITY IN DISEASES OF THE PHARYNX.—By Thomas L. Shearer, M. B., C. M.—"Journ. of Electro Ther.," July, 1896.

GALVANISM IN DISEASES OF THE LARYNX.—By J. B. Garrison, M. D.—"Journ. of Electro Ther.," July, 1896.

ELECTRO CAUTERY IN NASAL DISEASES.—By Wesley A. Dunn, M. D. Some suggestions as to the proper application.—"Journ. of Electro Ther.," July, 1896.

ELECTRO MEDICAL AND SURGICAL INSTRUMENTS.—By Laurence Stevenson. Their construction and use.—"Journ. of Electro Ther.," July, 1896.

Measurements:

LORENZ APPARATUS.—See synopsis July 15, 1896; also London "Elec. Rev.," July 10, 1896.

Mechanical:

STEAM PIPING FOR ELECTRIC RAILWAY POWER PLANTS.—By Geo. H. Davis, M. E. A discussion of eight distinct types of live steam fitting systems.—"Street R'way Journ.," July, 1896.

Mining:

PRECAUTIONS UNNECESSARY IN THE USE OF ELECTRICITY IN COAL MINES.—By H. W. Ravenshaw. Abstract of paper read before the Federated Institution of Mining Engineers. Author offers suggestions which may serve to minimize the risk from shock and fire. He discusses main conductors, junction boxes, switches, motors, motor magnets, motor armatures, and enclosed (ironclad) motors.—London "Elec. Engr.," July 3, 1896.

Miscellaneous:

MUNICIPAL ELECTRICAL ASSOCIATION OF ENGLAND.—The address delivered by Mr. Arthur Wright and an abstract of papers presented.—"Elec. Engr.," July 8, 1896.

Railways:

MILEAGE, LONG-DISTANCE RIDING AND TRANSFER SYSTEMS IN AMERICAN CITIES.—Information bearing upon the question of how much a passenger on the street railways of the larger American cities receives for his money. The total track mileage of the entire system, the longest distance which any passenger can ride, on payment of 5 cents or by transfer and general transfer privileges—"Street R'way Journ.," July, 1896.

TRACTION DIAGRAMS.—By Thomas Tomlinson, B. E. The unsatisfactory manner in which diagrams are now prepared is pointed out, and a general discussion on such diagrams from the points of view of their production, interpretation, and utility is commenced in London "Elec. Rev.," July 10, 1896.

ELECTRIC TRACTION.—By R. St. George Moore. Read before the Assoc. of Munic. and County Engs., Brighton, Eng. A review of the application of electric traction and a comparison with other methods.—London "Elec.," July 10, 1896.

ELECTRIC RAILWAY CONSTRUCTION IN GERMANY.—By Louis J. Magee. Artistic poles, various views of streets, a view of conduit construction in Berlin, and a general review of the German railway systems.—"Street R'way Journ.," July, 1896.

STUDIES IN ECONOMIC PRACTICE.—By C. B. Fairchild. Shop methods, tools and labor saving devices of the Chicago City R'way Co.—"Street R'way Journ.," July, 1896.

POWER DISTRIBUTION FOR ELECTRIC RAILROADS.—By Louis Bell, Ph. D. Author states that the following conditions must be met in planning a direct feeding system: (1) The maximum fall in voltage at any point in the system under all working conditions must not exceed a fixed amount. (2) The average drop throughout the system under normal conditions must equal a certain predetermined amount. (3) The feeders must be so connected that accidents to the working conductors shall interfere with traffic to as small an extent as possible.—"Street R'way Journ.," July 1896.

HARTLEPOOL ELECTRIC RAILWAYS.—By Albert H. Bridge. See synopsis of July 15, 1896, and "Elec. World," July 11, 1896.

PRINGLE AND KENT'S SURFACE RAIL ELECTRIC RAILWAY.—A closed conduit or surface sectional rail system, having all supply equipment underground. Details described and illustrated in London "Elec. Rev.," July 3, 1896.

A NOVEL SEASHORE ELECTRIC RAILWAY.—By Magnus Volk. A self-propelling car on a railway submerged in the sea.—"Cassier's Mag.," July, 1896.

Roentgen Rays:

ELECTROSTATIC DEFLECTION OF CATHODE RAYS.—By G. Jaumann. It is shown that electrostatic deflection of cathode rays is as characteristic of them as their magnetic deflection.—London "Elec.," July 10, 1896.

EFFECTS OF A STRONG MAGNETIC FIELD UPON ELECTRIC DISCHARGES IN VACUO.—By A. A. C. Swinton. Paper read before the Royal Society. Magnetic lines of force traveling parallel with the cathode rays develop some peculiar changes in the exhausted tubes.—London "Elec.," July 10, 1896.

NEW DEVELOPMENTS.—By Dr. Leroy. Presented to the Physiol. Soc., at Berlin, June 13, 1896. The results of successful diagnoses made by Profs. Goldstein, DuBois-Reymond, Grunmach, are recorded in "Zeitschr. f. Elektrotech.," July 1, 1896.

Telegraphy, Telephony, etc.:

CABLE WITH SELF-INDUCTION COILS.—By S. P. Thompson. Author's cable system with self-induction coils for the neutralizing of electrostatic capacity is explained in "Elektrotechn. Anzeiger," July 2, 1896.

UNDERGROUND CABLES FOR TELEGRAPHY AND TELEPHONY IN PARIS.—By N. Bean. A thorough treatise on the cables, subways, construction of underground lines, maintenance and repairs. The treatment is entirely from the practcial point of view.—"Ann. Télégraph.," July-August, 1896.

DUPLEX AND DIPLEX ON THE FRANCO-ENGLISH AND FRANCO-BELGIAN LINES.—By H. Toussaint. Description of the methods.—"Ann. Télégraph.," July-August, 1896.

INDUCTANCE AS A NEGATIVE CAPACITY IN SUBMARINE CABLES.—By A. Davidson. A record of experiments made on a length of submarine cable of modern type with steel wire and coiled in an iron tank.—"Elec. Engr.," July 8, 1896.

STORAGE BATTERY FOR FIRE ALARM AND POLICE TELEGRAPH PURPOSES.—By John L. Hall. Illustrated description of an installation just made.—"Elec. World," July 11, 1896.

INTER-IMPERIAL POSTAL AND TELEGRAPH ROUTES. Discussion at the third Congress of the Chambers of Commerce of the empire, held June 11, 1896.—London "Elec. Rev.," July 3, 1896.

INTERNATIONAL TELEGRAPH CONFERENCE, Budapest, 1896. List and addresses of government delegates and representatives of telegraph companies.—London "Elec. Rev.," July 3, 1896.

Transformers:

THE ALTERNATE CURRENT TRANSFORMER.—By J. D. Morse, and J. E. Pfeffer. A dissertation on the theory and construction.—"The Technograph," Univers. of Ills., May, 1896.

PENSON'S VENTILATOR.—A concentric ventilator for transformer boxes is illustrated and described in London "Elec. Rev.," July 10, 1896.

SINGLE-PHASE ALTERNATE CURRENT TRANSFORMER IN PRACTICE.—By A. F. Berry. Paper read before a meeting of student members of Lond. Inst. of Elec. Engrs. Discussion of open circuit losses with special reference to hysteresis effects.—London "Elec. Rev.," July 10, 1896.

Transmission of Power:

ELECTRIC TRANSMISSION OF POWER IN MINES.—By C. Költgen. Illustrations of various applications of electric power in mining. The figures bring out clearly the two chief individualities of electric transmission of power, viz., the possibility of leading the current to any desired point in the mine, and the flexibility of the wire leads to the motors. A short description accompanies the illustration in the Lond. "Engr.," July 3, 1896.

COMBINED ELECTRIC LIGHTING AND TRACTION PLANTS.—By John Hesketh and John H. Rider. Paper read before the Municipal Electrical Association with the object of showing that it is wrong to try to separate lighting from railway plants.—"Electricity," July 8, 1896.

Wiring.

EFFECT OF TEMPERATURE ON INSULATING MATERIAL.—By Chas. F. Scott. See synopsis of July 15, 1896, also "Elec. World," July 11, 1896.

HOPKINSON THREE-WIRE PATENT.—Arguments in favor and against an extension of the English patent.—Lond. "Elec.," July 3, 1896.

LOCALIZATION OF FAULTS IN ELECTRIC LIGHT MAINS.—By F. C. Raphael. From a forthcoming work. Description of Murray's loop method with numerical example.—Lond. "Elec.," July 3, 1896.

REGULATIONS FOR FITTING UP CONSUMERS' PREMISES.—Principally a discussion on the advisability of employing consulting engineers.—London "Elec. Rev.," July 3, 1896.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 20, 1896.

Alarms and Signals:—

AUTOMATIC FIRE ALARM SYSTEM. A. Speer, Toledo, O., 564,229. Filed May 3, 1895.

Comprises a circuit containing a relay and battery and controlled by a two-point thermostat, a second circuit controlling an alarm, a battery in said second circuit, and means controlled by the second point of the thermostat for throwing the batteries into combined action for sending the fire alarm.

ANNUNCIATOR. J. B. Rogers, Zillah, Washington, 564,314. Filed Oct. 31, 1894.

Adapted for hotel use.

ELECTRIC SIGNAL APPARATUS FOR ELEVATORS. S. C. Stickle, New York, 564,344. Filed Aug. 4, 1894.

Car-calling apparatus.

ELECTRIC MAT. O. H. Hicks, Chicago, Ill., 564,485. Filed Nov. 29, 1895.

The springs afford bridges for connecting the terminals when pressure is exerted upon the mat.

THERMOSTAT. H. F. Maxim, Norfolk, Va., 564,567. Filed Sept. 9, 1895.

Designed to sound an alarm in more than one place.

Batteries:—

CELL. J. Mercer, Rumford Falls, Me., 564,311. Filed Jan. 10, 1896.

A suitable body having an opening through its wall for the feeding of salt, a funnel upon the outside of the body and surrounding said opening, and a hood upon the inside of the body opposite the opening.

Conductors, Conduits, and Insulators:—

CABLE CLIP. R. H. Lewis, Providence, R. I., 564,433. Filed Dec. 30, 1895.

A sheet metal hook adapted to suspend the cable and draw the flanges together by the weight of the cable.

CONDUIT OUTLET BOX FOR ELECTRIC WIRES. C. A. Mezger, Brooklyn, N. Y., 564,527. Filed Jan. 25, 1896.

An outlet box having a series of weakened portions capable of being broken to form openings, the weakened portions serving to regulate the form of the break.

Distribution:—

ELECTRIC ARC LIGHTING. G. R. Lean, Cleveland, O., 11,559 (reissued). Filed Feb. 4, 1896.

Means for operating arc lamps in series on multiple arc circuits of high voltage and constant potential.

Dynamos and Motors:—

ALTERNATING CURRENT DYNAMO. M. Hutin and M. Leblanc, Paris, France, 564,200. Filed May 10, 1894.

Composed of field magnets of constant polarity, an armature of the Gramme or Siemens type having its commutator brushes short circuited, and a number of external circuits, looped from and in series with the armature coil-sections, and each containing a translating device.

ELECTRIC MOTOR. G. J. Scott, Philadelphia, Pa., 564,455. Filed Sept. 19, 1895.

Electroller fan motor.

SPEED REGULATOR FOR ELECTRIC MOTORS. R. Eickemeyer, deceased; R. Eickemeyer, executor, Yonkers, N. Y., 564,558. Filed Oct. 6, 1891.

Comprises the armature of the motor, the armature of an electric generator serving as a governor for the motor, a casing embodying a central frame and affording seats for a shaft common thereto, and provided with cheek pieces detachably secured to frame.

DYNAMO ELECTRIC MACHINE. R. Eickemeyer, deceased, Yonkers, N. Y.; R. Eickemeyer, Jr., executor, 564,559. Filed Oct. 7, 1891.

Two pairs of cheek pieces located on opposite sides of the armature, each pair similarly magnetized, and a counter field coil which strengthens the magnetism in diagonally opposite cheeks to both pairs, and weakens the magnetism in the other diagonally opposite cheeks.

Electro-Metallurgy:—

ELECTRIC METAL WORKING APPARATUS. H. Lemp, Lynn, Mass., 564,331. Filed June 15, 1891.

Comprises a flexible transformer secondary composed of pieces or strips of conducting material and having a single turn or bend, in combination with two work holders opposed to one another and fixed rigidly and directly to each piece of the secondary.

ELECTRIC METAL WORKING APPARATUS. E. E. Ries, Baltimore, Md., 564,453. Filed Nov. 9, 1889.

Comprises clamps for holding the metal to be operated upon and constituting the terminals of an electric heating circuit, and an electrically operated cutting tool mounted adjustably between the clamps.

Miscellaneous:—

ELECTRIC MASSAGE APPARATUS. G. Rossbach, Lichtenfels, Germany, 564,258. Filed Jan. 14, 1896.

Composed of a casing lined with metal and inclosing loosely a ball coated with a metal or other conducting substance.

MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES. M. Moskowitz, Newark, N. J., 564,333. Filed Nov. 1, 1895.

Means for securing the dynamo to the framework of the truck and having it operated by a friction wheel on the car axle.

MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES. M. Moskowitz, Newark, N. J., 564,335. Filed March 14, 1896.

Similar to above.

TRICK PLATFORM FOR BICYCLE RIDERS. C. M. Peck, New Haven, Conn., 564,392. Filed May 11, 1896.

Comprises a platform, a series of circuit changers arranged therein in position to be operated by the passage of a bicycle wheel over them.

ELECTRIC BLASTING MACHINE. J. Macbeth, Brooklyn, N. Y., 564,437. Filed Oct. 31, 1895.

Consists in a dynamo electric machine mounted in a case, with the axis of its armature arranged vertically, in combination with a propelling screw and a sliding nut for operating the same.

ELECTRIC ELEVATOR. G. T. Francis, Chicago, Ill., 564,480. Filed April 20, 1896.

A main frame, a motor mounted to travel back and forth in said frame and connections between said motor and the car.

ELECTRIC IGNITER FOR GAS ENGINES. Louis M. Bourgeois, Jr., New Orleans, La., 564,182. Filed June 7, 1895.

Embodies a rod sliding in a gland, properly insulated from cylinder of engine, with a pair of bent levers pivoted to sliding rod and a tapered rod fixed to piston, acting in conjunction with bent levers.

MAGNETIC CHUCK. Oakley S. Walker, Worcester, Mass., 564,296. Filed Feb. 13, 1896.

Comprises polar faces and adjustable magnetic strip, the edges of which form a raised surface from the chuck-face to extend the action of the magnetic lines at an angle to the face of the chuck.

Railways and Appliances:—

RAIL BOND FOR ELECTRIC RAILWAYS. F. H. Daniels, Worcester, Mass., 564,243. Filed June 15, 1895.

A cylindrical hole leading in from each end for the drift pin, and a separate tube or bushing open at both ends, and not split longitudinally, to fit over each end of the bond wire, and be secured thereon and in the hole in the rail, by the driving in of a drift pin.

ELECTRICAL TRANSPORTATION SYSTEM. P. K. Stern, St. Louis, Mo., 564,262. Filed Oct. 7, 1895.

A horizontally rotatable armature on the vehicle for propelling the same, and a primary arranged along the route for influencing said armature.

ELECTRIC CAR BRAKE. John C. Henry, Colorado Springs, Colo., 564,195. Filed July 15, 1895.

MEANS FOR GENERATING ELECTRICITY FROM CAR WHEELS. M. Moskowitz, Newark, N. J., 564,334. Filed March 14, 1896.

Employs flexible shafts to drive dynamo, said shafts being connected to the car axle.

MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES. M. Moskowitz, Newark, N. J., 564,336. Filed April 23, 1896.

A dynamo on truck frame, a pulley wheel on car wheel axle, a bracket on said frame, a swinging bar on said bracket, a pulley wheel on said shaft and belts.

ELEVATED ELECTRIC RAILWAY. E. W. Farnham, La Grange, Ill., 564,369. Filed Oct. 14, 1892.

The cars run on an elevated single track, which is particularly suited to promote the rapid transit of mail and light baggage.

ELECTRIC CAR TROLLEY. W. H. Russell, Newcastle, Can., 564,395. Filed Oct. 31, 1895.

Details of construction.

RAIL-BOND. T. Wallace, Ansonia, Conn., 564,415. Filed March 20, 1896.

A band of metal having each end brought to the form of a plug or socket, the metal of which is integral with the band and which plug or socket is shaped and properly adapted to be driven into a properly formed orifice in a rail.

Switches, Cut-Outs etc.:—

ELECTRIC SWITCH. J. T. Hunt, New York, 564,283. Filed May 12, 1896.

Details of construction.

OUTLET BOX. C. A. Mezger, Brooklyn, N. Y., 564,443. Filed May 19, 1896.

A series of openings for conduits, and closures comprising members integral with the box, and a separate member held by said integral member.

Telephones:—

TELEPHONE. E. A. Hickley, Owego, N. Y., 564,196. Filed Nov. 11, 1895.

Carbon balls are employed in transmitter.

TELEPHONE EXCHANGE SYSTEM. W. W. Dean, St. Louis, Mo., 564,328. Filed April 10, 1896.

Means for maintaining at constant strength the current in a system employing centralized batteries.

VOICE CONVEYOR FOR TELEPHONES. C. M. Fleury, Brooklyn, N. Y., 564,371. Filed Oct. 17, 1895.

Consists of a mouthpiece of peculiar construction.

OPERATOR'S KEYBOARD APPARATUS AND CIRCUIT THEREFOR. C. E. Scribner, Chicago, and F. R. McBerty, Downer's Grove, Ill., 564,456. Filed Sept. 28, 1893.

Similar to patent below.

OPERATOR'S KEYBOARD APPARATUS AND CIRCUIT THEREFOR. C. E. Scribner, Chicago, Ill., and F. R. McBerty, Downer's Grove, Ill., 564,457. Filed Jan. 10, 1894.

Consists of a centrally pivoted lever carrying a double wedge, push buttons adapted to act upon the different extremities of the lever to move the wedge in opposite directions, and switch springs and levers controlled by the wedge in its different movements.

KEYBOARD APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 564,458. Filed May 14, 1894.

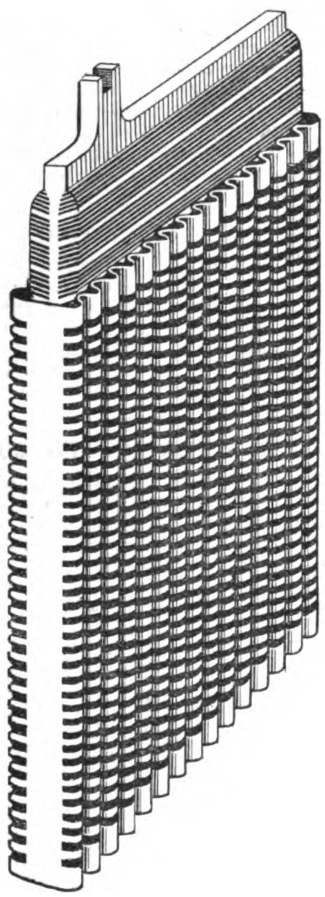
Employs a single key for each operator for signaling to the calling subscriber.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WILLARD STORAGE BATTERY.

THE WILLARD ELECTRIC AND BATTERY COMPANY, of 33 Sheriff street, Cleveland, O., are manufacturing the Willard storage battery, shown in the accompanying engraving. The company claim several points of superiority for their battery, among which the following may be noticed: The plates are made from pure rolled lead in such a manner that there is no waste of material, and after formation they present much larger surfaces than any other plates of the same weight. A



WILLARD STORAGE BATTERY PLATE.

plate 5 x 7 inches presents a surface of fourteen square feet. The manner of protecting the plate with a hard rubber cell, which is corrugated and highly perforated, so as to secure perfect circulation of the electrolyte, makes the battery very durable and long lived. This also enables it to withstand repeated rapid discharges without injury. There is no formation of mud in the Willard battery, and short circuiting or buckling is impossible. Whatever scaling off of formed material there may be, is kept in connection with the central portion and still remains active. These batteries are protected by patents, and, it is claimed, they do not infringe upon any other patents. The batteries are made for all purposes.

THE WATERTOWN ENGINE.

We have received a handsome catalogue from the Watertown Steam Engine Company, of Watertown, N. Y., which deals particularly with direct connected engines which they build for use with dynamos. The details of these direct-connected engines are identical with their well-known regular patterns of engines, with the exception of a long shaft to receive an armature and a special sub-base with an outboard bearing.

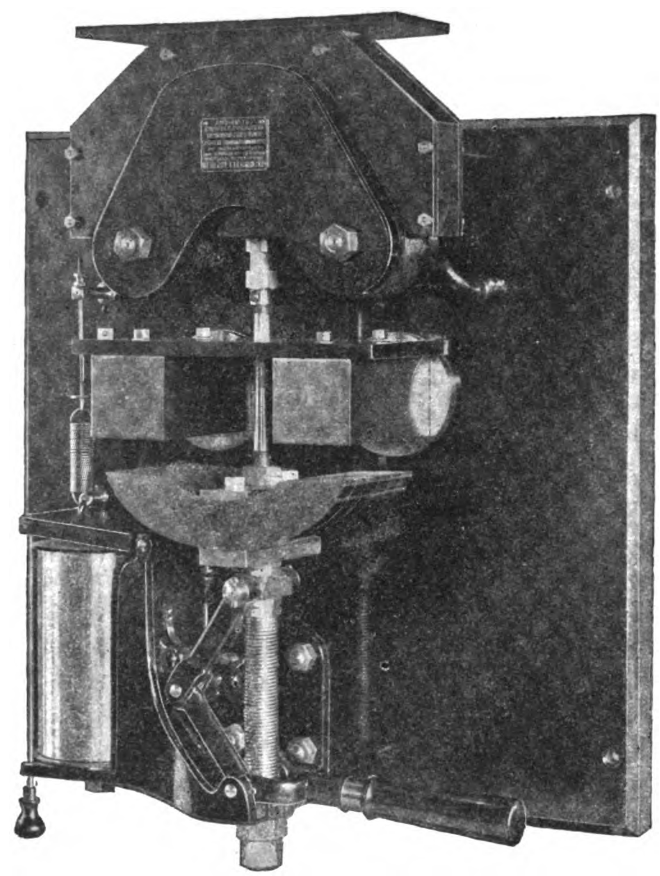
Unless a coupling is preferred the shaft for the armature is made in one forging with the engine shaft. It is cut from one solid forged block and has no weld or seam at any point. To this main shaft two crank discs are attached and their position is adjusted by means of a right and left-handed thread, without the use of soft metal. Both horizontal and vertical direct-connected engines are illustrated in this catalogue.

FISHER & CRAMPHORN SPECIALTIES.

Fisher & Cramphorn, corner of Congress and A streets, Boston, Mass., have published a catalogue of the large line of electrical specialties which they manufacture. Among these may be mentioned station switches of all kinds, fuse blocks and holders, wire terminals and connectors. One of their principal specialties is the Lyon brake handle which is now in use on a large number of surface railroads. Another article to which they call special attention is their electric door lock, of which they have placed large quantities in successful operation. It is of small size and requires comparatively little cutting away of the door. It can be used equally with both right-handed and left-handed doors, which, with these locks, cannot possibly be left unlocked.

AN 8,000 AMPERE CIRCUIT BREAKER.

The largest automatic circuit breaker ever constructed has recently been completed by the General Electric Company. It is designed to break a circuit of 8,000 amperes and is to be used on a 160-volt circuit, although made to handle the current at 600 or 700 volts. This is a form "K" circuit breaker and differs only in size from the well-known "K" instruments used by the General Electric Company on their standard railway generator and feeder panels. The studs which carry the current are 3¼ inches in diameter, the base is 23 inches square. It is constructed to open the circuit automatically at any point between 3,000 and 20,000 amperes, the opening point being arranged by the adjustment of a tension spring on the armature.



THE 8,000 AMPERE CIRCUIT BREAKER.

ELECTRICAL MICA AND MICANITE.

Eugene Munsell & Co., of New York, the well-known miners, importers and dealers in mica for electrical purposes, have issued a standard price list of their goods which include sheet mica cut to any shape or size, micanite products of all descriptions, and oiled paper, cloth and linen, all of which find extensive application for the purposes of insulation. The company will be pleased to quote prices on request to all persons requiring superior insulating materials of this nature.

THE JEWELL BELTING COMPANY have furnished the entire belt equipment for the Norwich, Conn., electric light station, just inaugurated.

ICE MAKING AND REFRIGERATION.

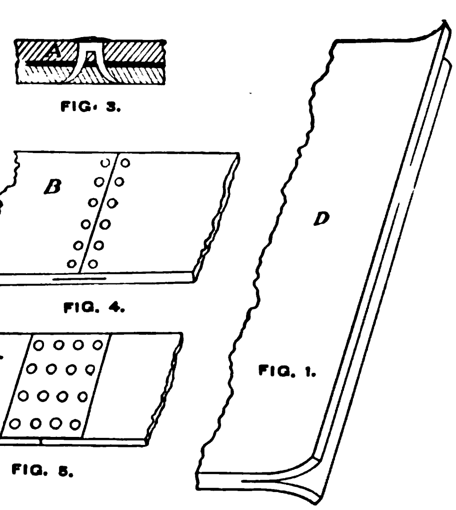
WESTINGHOUSE, CHURCH, KERR & CO., engineers, of 26 Cortlandt street, New York, have issued two handsomely illustrated and very instructive catalogues on the subjects of ice-making machinery and cold air refrigeration. The production of artificial cold and its utilization in an increasing variety of industries has received the attention of the best mechanical ability for the past twenty years. Various experimental stages involving the use of air, ether, sulphur-dioxide, etc., have ended in the universal adoption throughout this country and Europe of liquefied anhydrous ammonia as the refrigerating medium. In the use of ammonia two distinct systems have been exploited, known respectively as the compression and the absorption systems. The greatly preponderating majority of plants are constructed upon the compression system, the advantages of which, briefly stated, are a much higher efficiency in the use of coal and water per unit of work done; greater reliability of action, and a simple form of apparatus easily within the comprehension of the owner.

The two essential parts of an ice-making plant are a compressor and a condenser, both of which are fully described and illustrated in one of these pamphlets. The other one refers to the freezing room where the ice is manufactured and describes a number of methods of producing blocks of artificial ice, as well as pointing out the merits and drawbacks of each system. This company has perfected its systems during its long experience in this class of machinery, and will be pleased to extend full information and estimates to interested parties.

Electric light stations would do well to look into the subject as an additional source of revenue during light load hours.

THE NELLIS BELT FASTENER.

A new belt fastener is now being put on the market making the belt practically endless; it is designed to take the place of cemented joints, but at the same time keep the belt flexible and strong. The accompanying illustration explains this simple and efficient device. With the aid of a hand leather-splitting tool both ends of the belt are slightly split in half, as shown in the illustration, D. In this slit is inserted a specially cured material, stronger than the belt itself, and which at the same time does not increase the thickness of the belt to any appreciable extent. At A is shown a sectional cut of the belt and strip through which is inserted the rivet, A. The fastening as finished is shown at B. When a belt is too thin to split it is joined, as shown at C.



THE NELLIS BELT FASTENER.

The above mentioned belt fastener is manufactured by the Nellis Belt Fastener Company, 284 Pearl street, New York. This firm has also the sale of the Morse electric pulley covering which forms a permanent, continuous, endless and extremely adhesive surface to wood and iron pulleys and admits running machinery without the use of idlers and tighteners.

G. E. AND WESTINGHOUSE PROFITS.

It has been stated unofficially that both the General Electric and the Westinghouse companies are doing better both gross and net than they have done since early in 1893. "The Wall Street Journal" states that the General Electric Company increased its net earnings in June $204,000 over the net of June last year. A prominent operator said: "I believe General Electric to be the cheapest stock on the list, but its net earnings will fall as flat as do the big earnings of St. Paul and Northern Pacific. Important matters like these in ordinary times are now, under the political strain, like a glass of water thrown in the desert."

MR. J. P. MORGAN'S OPINION OF THE BELL CO.

Mr. J. P. Morgan is said to have declined a Bell Telephone directorship, remarking that he bought the stock as an investment, and considered this the best managed corporation in the country.

IRON CLAD FAN MOTOR RHEOSTAT.

In these days of variable temperature and humidity one frequently finds it desirable to change the speed of the refreshing fan, but the changes usually provided by the motor switch rarely give a range of variability commensurate with the changing conditions of the atmosphere. To meet this want the Iron Clad Rheostat Company, of Westfield, N. J., have designed a small 9-point rheostat that occupies no greater space than an ordinary book. One of these baby rheostats which the company has kindly placed at our disposal has helped greatly to mitigate the discomforts of the past few weeks.

ROYAL ALTERNATORS.

The Royal Electric Company, of Peoria, Ill., manufacturers of the well-known Royal alternators, have issued a pamphlet devoted exclusively to testimonial letters for the consideration of all interested in the operation of electrical machinery. We note these machines are in use in all sections of the country and are highly spoken of by numerous electric light station managers and others who have had them in operation.

BROWN & SHARPE MFG. CO.

A handsomely illustrated souvenir catalogue has been issued by the Brown & Sharpe Manufacturing Company, of Providence, R. I., giving a large number of views of their factory and also an illustration of the company's exhibit at the World's Fair, Chicago. The catalogue indicates the nature and extent of the facilities which this company have for the manufacture of machine tools of every description.

PENBERTHY INJECTOR CO.'S 100,000 CELEBRATION.

On Saturday, July 25, 1896, the Penberthy Injector Company, of Detroit, Mich., celebrated the event of the manufacture and sale of 100,000 Penberthy injectors during a period of ten years. Their first injector marked No. 1, was turned out June 5, 1886, and on May 12, 1896, No. 100,000 was manufactured.

The company tendered a holiday and an excursion to their employés, to which a large number of their customers and friends were also invited. A steamer carried the party to Beauvoir, St. Clair River, where refreshments were served, after which music, dancing and games were on the order of exercises. The party returned home after passing a most enjoyable day.

WHITE-CROSBY CO.'S WORK.

THIS enterprising concern report an unusually large amount of work this summer, all of which has been contracted for since February last. Their work on hand comprises about ten miles of track and overhead work for the Norwalk Tramway Company, five of which are completed and in operation; also six miles of complete line for the Rahway and Sewaren Electric Railway, which is about completed, and five miles of overhead work including fifteen miles of feeders for the Bergen County Traction Company. This line is completed and in operation.

Their work in Baltimore includes the following plants: A contract with the Baltimore City Passenger Railway Company for special and overhead work connecting one of their cable tracks with an electric line; five miles of overhead for the Baltimore Traction Company, on their new Westport line; five miles of extra feed wire for the Baltimore Traction Company, to give them sufficient power for their baseball business; equipping the Druid Hill avenue cable line of the Baltimore Traction Company, for electric service; two thousand feet of subway for the Baltimore and Ohio Railroad Company, to enable them to light their new Mount Royal station from their present power house, which operates the Belt Line tunnel electrically; equipping the overhead extension of the Gwynn-Oak line of the Baltimore Traction Company, and building and equipping the smallest electric railway in the country, which connects with the Walbrook extension of the Baltimore

Traction Company. This road is only about three thousand feet long, and is complete within itself.

The White-Crosby Company are the electrical engineers for the Helena and Livingston Smelting and Reduction Company's new plant. This is a power transmission plant, including two 225 kilowatt, and five 150 kilowatt Crocker-Wheeler 500 volt machines, the distance of transmission being 1½ miles.

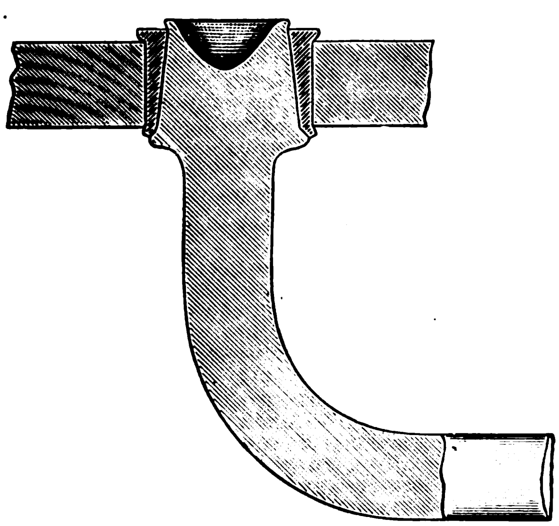
They are also electrical engineers for the Helena Water and Electric Power Company, which is installing Westinghouse alternating apparatus, to transmit power to East Helena and Helena, twelve and seventeen miles, respectively. The station is planned for eight 650 kilowatt generators, four of which are now being installed, step-up transformers, step-down transformers, and the necessary station apparatus. The voltage will be about 10,000 on the transmission line, distributing through Helena and East Helena at required voltages.

They have also completed about five miles of the Atlantic Highlands, Red Bank and Long Branch Electric Railway, and will finish the line by fall.

THE COLUMBIA RAIL BOND.

The Columbia rail bond, manufactured by the John A. Roebling's Sons Company, Trenton, N. J., and which is shown in the accompanying engraving, is composed of three parts, two copper thimbles and the connecting copper rod. On each end of the copper rod is a truncated cone head with a fillet at the base. The inside of the fillet is tapered to fit the head on the bond while its outside is slightly tapered in the opposite way.

In applying the bond, the cone-shaped heads are placed in the holes in the rail from one side and the thimbles are slipped over them from the other. A portable hand-press is then applied, and the wedge-shaped head of the bond is forced into the thimble so that it is not possible to see the line separating



THE COLUMBIA RAIL BOND.

the thimble and the head in a cross-section of the two. The end of the head of the bond is expanded by a center-punch, held in position in the press.

When installed, owing to the pressure exerted between the head and thimble, and also to the fact that they are of the same kind of metal, the two become one, both electrically and mechanically. It therefore has all the advantages which may be claimed for a one-piece bond, and at the same time can be satisfactorily installed, as no riveted bond can be. The contact with the rail is seven times the section of the wire, providing ample contact to compensate for the poorer conductivity of the steel in the rail.

THE BERNSTEIN ELECTRIC CO.

Mr. James Bradley has been appointed treasurer of the Bernstein Electric Company, of Boston, in place of Mr. Henry B. Cram, resigned. The Bernstein Company have recently moved their offices to their new factory, at 355 Congress street, and will hereafter have no office at 620 Atlantic avenue. Mr. Bradley has for years been manager of the Bernstein factory, and has a large and valuable experience in the manufacture of incandescent lamps, both for series and constant potential circuits, and with his intimate knowledge of the wants of the electrical trade will undoubtedly be able to maintain the success which the Bernstein Company has already achieved for the excellent quality of its goods.

THE ELECTRIC STORAGE BATTERY CO.

The adoption of the storage battery in central station practice in this country seems to be an assured fact. Within the past few weeks the Electric Storage Battery Company has contracted to install batteries of chloride accumulators in the stations of the Boston Edison Company (their third plant), the New York Edison Company (their second plant), the Brooklyn Edison Company, the Easton (Pa.), Edison Company, the Hartford Electric Light Company (the largest battery in the world), the Claremont (N. H.), Electric Light Company, the Woonsocket (R. I.), Electric Machine and Power Company, etc.

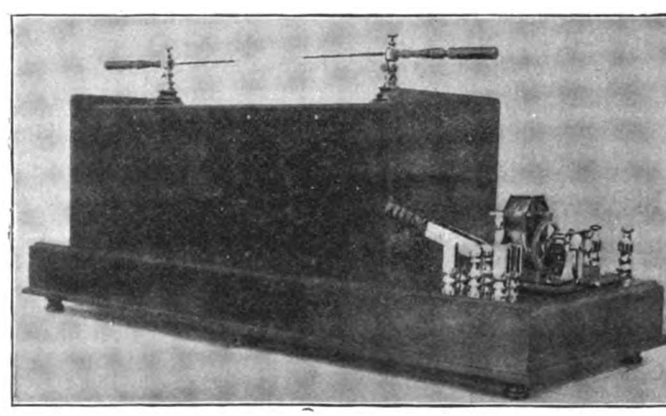
The company has also recently closed contracts with the government for batteries for the New York Custom House, West Point Military Academy, Ford's Theater, Washington, D. C., which is a government building, and the Brooklyn Navy Yard.

Installations of chloride accumulators are now being put down in the Germantown (Pa.), Hospital, College of Physicians and Surgeons, New York, for lighting the Sloane Maternity Hospital, St. Paul's M. E. Church, New York, and in the residences of Mr. Henry Villard and Mr. J. J. McComb, at Dobbs' Ferry, N. Y.

EDWARDS & CO.'S 12-INCH RUHMKORFF COIL.

Messrs. Edwards & Co., of New York, are building a 12-inch Ruhmkorff, for which they claim several points of superiority.

The coil is divided into sections by rubber discs and double covered silk wire is used on the secondary as an extra precaution. The motor interrupter is constructed so that it



THE EDWARDS & CO.'S 12-INCH SPARK RUHMKORPF COIL.

may be operated by hand. Its heavy platinum contact points are arranged with screw cups so that they can be readily renewed. All fittings are made of solid bronze.

The coil is mounted in a heavy hard-rubber case on a polished mahogany base. Its size over all is: Length, 3 feet 4 inches; width, 15½ inches; height, 20 inches, and it weighs about 175 pounds.

THE CENTRAL ELECTRIC CO.

The Central Electric Company, of Chicago, who are doing a large business in Lundell fan motors, are distributing a handsomely engraved card to draw attention to the utility of these machines. The cut represents a lady in classic costume enjoying the breeze from a Lundell fan motor, which she is crowning with a wreath of laurel. The machine is mounted on an ornamental pedestal. One corner of the card also draws attention to the fact that "Okonite never disappoints."

ELECTRIC POWER IN TIFFANY'S FACTORY.

The new factory which Tiffany & Co. are completing at Forest Hills, N. J., will be operated entirely by electricity, not a steam-driven machine being employed beyond the limits of the power house. The present factory and force at 53 Prince street, New York, will be moved out as soon as the electrical apparatus is installed.

The electrical plant will consist of two 125 horse-power, 250 volt General Electric dynamos, which will furnish current to more than twenty motors, scattered through the building. This will be 300 feet long in front and will have three wings each 100 feet long extending back of the main building. Of these motors some may be attached directly to the machines, and some will drive a number of machines by belts from a shaft.

The electrical system of power distribution in the Tiffany factory has been adopted as more economical and desirable than any other known method, and only after careful calculation and comparison with the results obtainable from a distribution of power to shafting by belts from steam engines.

NEW YORK NOTES.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., have recently shipped several of their automatic notching presses for armature disks to France. They do an extensive export business.

MR. T. T. GROVER, who for a long time was associated with the Electrical Construction and Supply Company and R. B. Corey, has accepted a position as selling agent in the lamp department of the Diehl Manufacturing Company.

THE BABCOCK & WILCOX COMPANY publish a card in another column to the effect that no change has been made in the location of any of their offices, and that no outside concern is authorized to build or contract for their boilers.

THE street cars in the City of Mexico are being changed from horse to electric cars. The Sterling Supply and Manufacturing Company, 97 Bank street, New York, are supplying the fare registers for the same. This firm manufactures also brakes, sand boxes, and fenders.

EDWARD J. M'EVOY, 157 Cedar street, New York, since he has been in business, has been furnishing Messrs. Cramps Sons, the shipbuilders, with all their china insulation. The branch cut-outs on the steamers St. Louis, St. Paul, New York and many other ships are of his make.

MR. J. E. SAYLES, late General Agent of the New York Edison Electric Illuminating Company, will henceforth represent the American Electric Heating Corporation in New York. Mr. Sayles has opened an office at 26 and 28 Cortlandt street, and has begun an active campaign in pushing his company's apparatus to the front.

JOHN G. KLUMPP & SONS, 13 Baxter street, New York, are running busy with a force of 20 men on large orders for round switch bases and desk telephone bases. This firm manufactures turned wood work, boxes, etc., for the electrical trade and with improved machinery has special facilities for filling orders at short notice.

THE E. G. BERNARD COMPANY, of Troy, N. Y., have closed a contract for a 10,000 light plant for the House of Refuge, Hudson, N. Y. Work will be commenced at once, and it goes without saying that Bernard dynamos will be used, and Mr. Bernard is now in the market for engines, boilers, lamps and other supplies.

THE VARLEY DUPLEX MAGNET COMPANY, 46 East Houston street, are finding a steady demand for their duplex magnets, which they wind for all purposes. With the peculiar method of winding which they control they are able to produce a magnet of equal power at lower prices than was heretofore possible. They have also a shop thoroughly equipped for experimental work for manufacturers.

MR. C. S. HAMMER, of the Middletown Light and Power Company, reports placing contracts for sixty arcs and 200 32-candle-power incandescent street lamps. He is superintending this installation and in connection therewith is remodelling the whole plant for the town, putting in a 250 horse-power Armington & Sims cross compound engine, a 300 light Stanley alternator and a 125 light Brush machine.

M. R. RODRIGUES, 19 Whipple street, Brooklyn, is handling considerable business despite the general stagnation now prevalent. Mr. Rodrigues is finding quite a demand for his small motors, which have been found to be very successful for the purposes to which they are adapted. Mr. Rodrigues is frequently called upon by other manufacturers to turn out apparatus for them, which, with his thoroughly equipped shop, he is perfectly qualified to do.

BAECHTOLD & PARKER ELECTRIC COMPANY, 79 Washington street, Brooklyn, have been quite successful with their new style of armature, which they have furnished to a number of central stations throughout the country. By the peculiar method adapted in manufacturing this armature the machines in which they are placed have a greater output with the same number of revolutions. This company is also finding quite a little business for the arc lamps which they make.

LINDNER & REMIG MANUFACTURING COMPANY, 329 West Twelfth street, New York, chandelier manufacturers, are making special flower designs in combination electric gas fixtures which they have placed in many churches and public buildings. Their work at the Fort George Casino, 196th street and Amsterdam avenue, New York City, is admired by the thousands who visit this well-known resort. The building has a 100 light and six 50 light chandeliers of this company's make, as well as a few hundred of their electric and gas fixtures.

THE DEWITT BROWN CEDAR COMPANY, Menominee, Mich., have issued a very comprehensive price list to the electrical trade. This list is devoted exclusively to the needs of electric light, telephone, telegraph and street railway companies, and prospective purchasers of poles will find it very useful to have one by them for reference, as it gives the dimensions, weights, and prices of the standard sizes. This young and progressive concern has closed quite a number of good contracts lately, amongst them being those with the Bell Telephone Company, of Missouri; Winona Telephone Company, Winona, Minn.; Bishop Telephone Company, of Central City, Ia.; Beaver Valley Traction Company, Beaver Falls, Pa., and others.

THE J. H. M'EWEN MANUFACTURING COMPANY, Church and Cortland streets, New York City, report the following sales of Thompson-Ryan dynamos and their engines, for the month of June: One 60 kilowatt belted and one 100 kilowatt direct-connected dynamo, with a 16 x 16 in. McEwen engine, to the Jeffrey Manufacturing Company, Columbus, O.; one 50 kilowatt and one 100 kilowatt dynamo, direct connected to 12 x 12 in. and 15 x 16 in. McEwen engines, to Bissell, Dodge & Erner Company, Toledo, O.; 100 kilowatt and 150 kilowatt belted machines to the Link Belt Machinery Company, Chicago; a 30 kilowatt belted machine to the Jeffrey Manufacturing Company, Columbus, O.; a 25 kilowatt belted machine to the New York Safety Insulated Wire Company; one 200 kilowatt and one 400 kilowatt dynamo direct connected to a McEwen tandem compound engine, to the Tacony and Frankford Electric Railway Company, Tacony, Pa. The latter order is the second one placed by this company, who have been using two of the 200 kilowatt direct connected units.

The other engine sales for the same month were as follows: One 9 x 10 in., to M. W. Johnston & Co., Chicago; one 6 x 10 in., to the Elk Tanning Company, Philadelphia; one 13 x 14 in., and one 8 x 10 in., to the Jeffrey Manufacturing Company, Columbus, O., and one 13 x 14 in., to the Scranton Electric Construction Company, Scranton, Pa.

PHILADELPHIA NOTES.

MR. R. H. ENGLE, inventor of a novel illuminating sign for street cars, is preparing signs for cars on the Arch street line.

THE many friends of Mr. D. C. Spruance will be pained to learn of his severe attack of nervous prostration while stopping at The Senate, Atlantic City, N. J.

MR. CHAS. PARKER BREESE, formerly of Breese & Mansfield, has opened offices as consulting engineer at 57 to 59 Manhattan Life building, Fourth and Walnut streets.

THE firm of Sheble & Pallor has been dissolved by mutual consent and will be continued by Mr. Franklin Sheble, as electrical engineer and contractor at the old quarters, 1028 Filbert street.

MR. F. MANSFIELD, of 1120 Betz building, who has for some time acted as Philadelphia representative of the Walker Company, of Cleveland, has admitted as a partner Mr. Wm. G. Bain, formerly of Boston. The firm will be known as Mansfield & Bain, electric railway engineers, and will continue to act as agents for the Walker Company.

THE PARTRICK & CARTER COMPANY'S employés' annual outing was held at Wenonah, N. J., a large number of those participating making the run on their bicycles under the leadership of Capt. Tom Townsend. After a lively game of base ball lunch was served and with the cigars and coffee came speeches. Mr. Charles M. Wilkins, a member of the firm, praised the faithfulness of the employés, and was replied to by Capt. Townsend, who presented Mr. Wilkins with two photograph groups of employés. The affair will be long and pleasantly remembered by those who participated in it.

NEW ENGLAND NOTES.

MR. H. W. HOBBS has opened an office at 57 North Main street, Fall River, Mass., for the sale of Westinghouse dynamos, motors, etc., and Westinghouse engines, together with general supplies. Mr. Hawks will also act as agent for the Hawks Electric Company, with which company he was for four years, in the capacity of superintendent.

THAYER & CO. were incorporated this month to place on the market the Caball vertical and Babcock & Wilcox horizontal safety water tube steam boilers, built by the Aultman & Taylor Machinery Company. The company have offices in the Tremont building, Boston; Drexel building, Philadelphia, and in the Taylor building, 39 Cortlandt street, New York.

MR. AUGUST BECKER, of Boston, is enjoying a well-earned success in the manufacture of name plates for dynamos, motors, engines, machines, and for all mechanical goods where name plates can be used. Mr. Becker has been identified with this class of business for many years and exercises great artistic taste in the design of his plates, having also been an expert designer and engraver for many years. Companies desiring first-class goods at moderate cost would do well to consult Mr. Becker.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. AUGUST 12, 1896. No. 432.

Electric Lighting.

ON THE PROPER USE OF SAFETY FUSES AND MAGNETIC CIRCUIT BREAKERS.

Wm. Baxter Jr.

In the days when electricity was truly in its infancy, one of the first facts discovered by those who were engaged in the actual operation of dynamos was, that some means must be provided for opening the circuit whenever the current strength rose beyond a certain limit. Two methods suggested themselves for accomplishing this result: The blow-out fuse, and the magnetic cut-out.

The fuse became the most popular, owing principally to its cheapness and extreme simplicity. Notwithstanding all the good things that may be said of the fuse for past services, it is a crude device, and should only be used in what may be termed its own sphere of usefulness. This sphere is for the protection of branch circuits.

In a lighting plant all the branches may be protected by fuses, but in the main circuit they are of little, if any, value, owing to the fact that their carrying capacity must be considerably above the normal current to avoid blowing out with such frequency as to be annoying. In branch circuits, if a fuse is used that will give way with a current of double the normal capacity, it will afford all the protection necessary, providing the wiring is of such proportions as to keep the line loss within reasonable limits. But if a fuse of similar proportions were used to protect a generator, it would be of no value. If the load on a generator is very uniform, a fuse may be used that is nearer to the normal current than two to one; but even under the most favorable conditions, if the margin is made less than fifty per cent., the frequency with which the fuse will blow out will be greater than would be admissible in most cases. Considering the foregoing facts, it is evident that a fuse placed in the main circuit of a generator will afford very little protection.

A question that has been agitating the minds of quite a number of central station managers of late, and one which is worthy of very careful consideration, is, whether it is advisable to use station safety cut-outs of any kind? Those who advocate discarding them claim that the occasional discontinuance of the current, when these devices act, causes dissatisfaction among the customers, and that it is better to suffer the loss caused by a burnt out armature now and then to loss of prestige in consequence of unsatisfactory service. There is a great deal of truth in this, and no doubt the desire to guard against loss occasioned by burn-outs due to excessive current, is a relic of the days when economy of operation was considered of more importance than efficient service.

The use of safety devices may be entirely discarded in central stations without incurring the danger of burn-outs, if the capacity of engines and generators is in proper proportion. In cases where a number of machines are operated by a single engine, each one supplying an independent circuit, safety devices may be used, and the conditions may be made such that the cut-outs will very seldom come into action. To illustrate the truth of these statements, take the case of an engine driving a number of generators in parallel. All the safeguard necessary may be obtained by making the power of the engine less than the combined capacity of the generators, and providing each of the latter with an effective device for maintaining a constant electromotive force.

The common practice has generally been to have the engines of ample capacity to do the work; this, when properly interpreted, means that they should be of sufficient power to drive the generators at their maximum output, and still have a margin left for an emergency. But it is these emergencies that are fatal to the generator, and to provide the engine with a reserve capacity to meet them amounts to providing means for burning out armatures whenever the circuit becomes overloaded. If the steam engine is overloaded, it will suffer no injury, the most that can happen will be that the speed will reduce, and if the overload is sufficient, the engine may be brought to a standstill. The generator is quite different, however, and, like the faithful horse, will work until it drops dead.

It may be said that even if the combined capacity of the generators is greater than that of the engine, there will still be danger of a burn-out, because the current in any one machine may rise above the average. This would be true, providing no provision were made to prevent such contingencies. Generally, generators coupled in parallel are connected by an equalizing wire, which, while not able to maintain a perfect uniformity, tends to keep the difference in current so low as to be within the safe limit. Still greater certainty could be obtained by providing each generator with an automatic switch, that would vary the resistance in the shunt circuit in accordance with variations in the strength of current passing through the armature.

If the generators are not connected in parallel, but are used to supply independent circuits, there will be little or no danger of burn-outs, if the capacity of the machines is greater than the demands of the circuits they supply; and this danger can be made still less by using cut-outs set to act at a point just below the safe limit.

Where each generator is driven by an independent engine, all danger of burn-outs from excessive current can be removed by this simple expedient of increasing the capacity of the generator. If you consult an engine builder, he will say that to drive a 100 kilowatt generator, an engine of at least 175 horse-power should be used, and that 200 horse-power would be better. This advice he gives, because from his experience he believes that the generator will be forced beyond 100 kilowatts so far as to prevent good regulation with a smaller engine. Now if you install a 100 kilowatt generator with a 200 horse-power engine, and then begin to overload the current, the generator will surely get into trouble before the engine begins to feel the strain. If you consult the generator manufacturer as to the size of engine, he will probably say that 150 horse-power is ample, but even this is too much, if perfect safety is desired.

To guard effectually against burn-outs, the proper plan to pursue is to ascertain the demand of the circuit, either actual or estimated, then provide engine capacity sufficient to meet this, making a fair allowance for loss in the generator, and a margin for abnormal demands. Then provide a generator that when working within the limit guaranteed by the makers will absorb the maximum power of the engine.

From the foregoing it will be seen that cut-outs and blow-out fuses in the main circuits of central stations and isolated plants are not necessary, and that all the protection they can possibly afford, can be obtained by simply enlarging the capacity of the generators.

The only proper place for blow-out fuses is in branch circuits, and then they are necessary to prevent overheating the wires in case the current should become abnormally large from any cause.

Fuses are very generally used to protect motors, but for that purpose they are of very little value. A magnetic cut-out is the only proper safeguard for a motor, and to be of real value, it should operate either with an excessive current or no current at all. It is not an uncommon thing for the current through a motor to be interrupted, and in such cases, if the switch is not opened, serious damage may be done when the current is established again. If the cut-out works both ways, mishaps in most cases will be avoided, because as soon as the current stops, the circuit will be opened.

There are cut-out switches of this kind on the market and, judging from their general appearance, they should be effect-

ive, but few of them are in actual use. The fuse is the mainstay and also the source of no small amount of annoyance, owing to the fact that it can be easily blown in the act of starting the motor if the attendant is inexperienced. Whenever they blow out, there is more or less delay in inserting a new one, and also an expense which, although small, runs up to an appreciable amount by the end of the year. Owing to this annoyance and expense, the size of fuse is increased in many cases to a point where it is simply no protection whatever, as it can carry more current than the motor. If cut-outs were used, they would be set to act nearer to the working capacity than is the case with fuses, because if they should act, they could be reset in a few seconds by the simple movement of a lever.

THE BUFFALO AND NIAGARA FALLS ELECTRIC LIGHT AND POWER CO.

BY ORRIN E. DUNLAP.

THE Buffalo and Niagara Falls Electric Light & Power Company have been making large expenditures lately to bring their station to the modern point of efficiency, and the results of their effort show that they are succeeding admirably. The names of the principal cities of Erie and Niagara counties have been included in the company's name because their franchise allows them to operate in both these counties and for the further reason that both Buffalo and Niagara capital is invested in the plant. This company probably has the greatest amount of electric energy at its command of any similar concern in the world. This is so because they are the distribut-

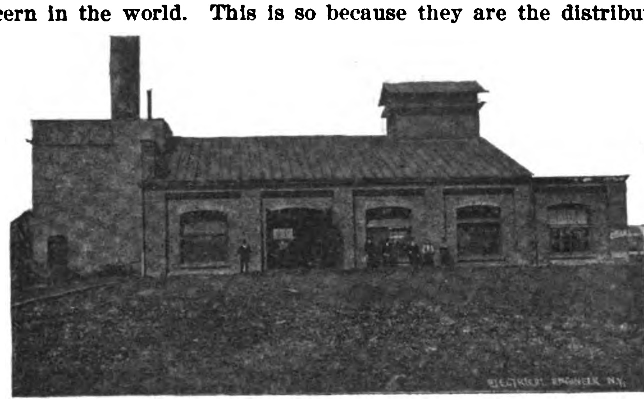


FIG. 1.—THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT & POWER CO.'S STATION.

ing agents in and about Niagara Falls, beyond the limits of the lands of the Niagara Falls Power Company, for the electricity generated in the mammoth plant of the last named company. This is becoming an important feature of their business, and the fact that their station is located on Buffalo avenue almost opposite the Niagara Falls Power Company's power house gives them an important advantage in operating their plant.

The officers of the Buffalo and Niagara Falls Electric Light & Power Company are: George Urban, Jr., of Buffalo, president; Hon. Walter P. Horne, Niagara Falls, vice-president; Edward Michael, Buffalo, secretary; Henry Koons, Buffalo, treasurer. The superintendent and manager is Mr. J. P. Chapin. This company became the successor of the Brush Electric Light & Power Company in the fall of 1893. Their plant was then located on the canal basin of the Niagara Falls Hydraulic Power & Manufacturing Company. In the summer of 1894 the present fine station, shown in Fig. 1, was built. It is of brick, 95 feet long and 62 feet wide at the foundation. It is divided into a dynamo room, boiler house, oil room, machine shop and offices, the dynamo room being 60x60 feet in size. Two stacks 30 feet high rise from the boiler house. The steam plant of this station consists of one 350 horse-power Corliss engine, 24x48-inch; one 12x12-inch John T. Noyes 100 horse-power engine and two boilers of 175 horse-power each.

The dynamo room is an interesting place for the visitor. It contains two 300 horse-power motors made by the Westinghouse Company, embodying the latest development in electric motors. Fig. 2 gives an excellent idea of one of the motors which are of the self-starting induction type designed to operate at a speed of 500 revolutions per minute when supplied with current of 3,000 alternations per minute and 2,000 volts pressure.

The revolving or primary element in the machines, is shown in Fig. 3. The core is 36 inches in diameter and 14 inches long inside the end plates. It is built of laminated steel; each disc is punched with 120 slots around its periphery and these

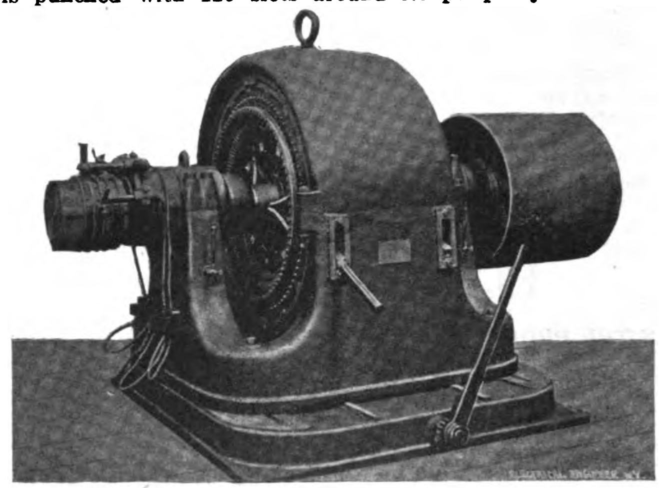


FIG. 2.—SELF-STARTING INDUCTION MOTOR.

discs, when superimposed one upon another, form longitudinal grooves into which the conductors are placed. As will be seen by the illustration the core contains five ventilating ducts, three-eighths of an inch wide. The conductors consist of machine wound coils, separately insulated with fuller-board and mica. The winding is tapped at suitable points and the leads pass through the shaft to the rings, which receive the current from the brushes.

In Fig. 4 is shown the stationary or secondary member which is also built up of slotted steel discs. Each slot contains one rectangular copper conductor, and all the conductors are secured to an iron ring on each side of the machine, as shown. Outside the iron rings are two copper rings, each carrying 82 small copper brushes, one for each conductor. The copper rings are rotated so as to either connect or disconnect the brushes and the conductors, as will be explained further on.

The machine is started as follows: The copper brushes mentioned above being disconnected from the conductors in the secondary, the switch through which current is supplied to the collector rings is closed and the motor starts. As soon as a fair speed is attained, one side of the secondary is short circuited through the copper ring by connecting the copper brushes with the secondary conductors. This is accomplished by means of a ratchet movement and the handle shown issuing from the side of the machine in Fig. 2. Then the other

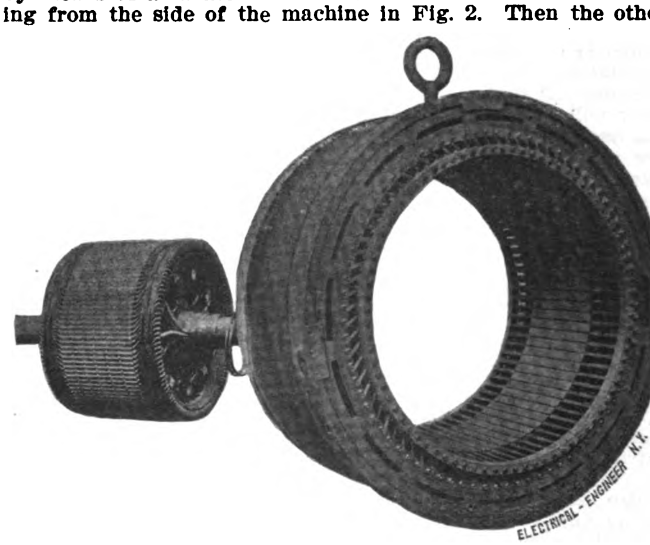


FIG. 3. FIG. 4.

side of the secondary is short circuited in the same manner. The object of the short circuiting device is to limit the flow of current when starting. The iron ring, being of comparatively high resistance, prevents the induction of very large currents in the secondary, which, when the primary is at rest, acts precisely as the secondary of a transformer and therefore if the secondary conductors were short circuited by

the copper rings when the switch was thrown in the primary current would be excessive.

Still another novel feature of this station is that the company buy as well as sell current, their purchases including both alternating and direct current. The current used to operate the Westinghouse motors is of the two-phase alternating type and reaches the station over four cables, each about one inch in diameter, laid in a tile conduit about eight feet underground. As it extends along Buffalo avenue the conduit is composed of eight 3-inch hole tile, to provide for other cables as the future may demand, but on the company's land the conduit is formed of one 8-inch tile in which the cables are laid. The switchboard has Shallenberger recording wattmeters and is in direct connection with the power house of the Niagara Falls Power Company. It controls the current supplied to the 300 horse-power motors.

Besides the current used for operating these motors the company buy power from the Niagara Falls Power Company, which they distribute to planing mills, machine shops, hotels, stores and small factories for running motors. This current passes through the rotary converters in the Niagara Falls Power Company's power house and is taken from the street railway feeders.

The dynamo room of this plant has undergone quite a few changes of late through the installation of the Westinghouse motors and the discarding of old light machines to make room for four new 100 light Brush 5,000 volt machines.

In addition to the motors and light machines mentioned, the dynamo room contains a 4,000 light Westinghouse alternator, the engines mentioned, a 60-light Brush machine and a switchboard connecting the city circuits. Two incandescent and four arc circuits are operated, the field of distribution at present including all the territory within the limits of the city of Niagara Falls.

In all that the Buffalo and Niagara Falls Electric Light & Power Company do they seek to build well and to establish their plant on lines which will be fully equal to the ever-growing demands of the Electric City of the World.

FIRE HYDRANTS AND MUNICIPAL OWNERSHIP.

BY W. S. MONROE

I have been much interested in the various papers which you have published recently descriptive of electric light plants and central stations, and upon the relative advantages of municipal or private ownership of electric light plants. I am of the opinion, however, that it is well nigh impossible to summarize the results of many plants, because the conditions vary so widely in different ones, and lists can easily be made to substantiate either side of the argument. Each plant should be considered separately, giving due value to all the different conditions, although this of course is a lengthy process.

In your issue of July 29 I noticed the report of Mr. W. W. Bean to the citizens of St. Joseph, Mich., in regard to the South Haven plant. If I do not misunderstand his figures, he makes the total cost of operation, including interest and depreciation of the waterworks and electric light plant, amount to $7,125 for one year's operation of the waterworks, and six months operation of the electric light plant. He then gives a statement showing that the seven arc lights cost the city $16 per month, and 80 incandescent lights $3.46 per month. His statement is as follows:—

Waterworks and electric light receipts	$3,450.00
Sixty-seven hydrants at $20 each	1,340.00
Seven arc lights, 1,200 candle power, at $16 per month	672.00
Eighty 32 candle power incandescent lights, six months, at $3.46 per month	1,663.00
	$7,125.00

I cannot see but that in consideration of the figures which he takes for the cost of operation he should charge the 67 fire hydrants for the entire year, and $40 a year is certainly not a high price for hydrants. If this is done, the seven arc lamps may be shown to cost about $6 per month and the eighty 32 candle power incandescent only $1.55 per month, as follows:—

Waterworks and electric light receipts	$3,450.00
Sixty-seven hydrants at $40	2,680.00
Seven arc lights, six months, at $6 per month	252.00
Eighty 32 candle power incandescent lights, six months, at $1.55 per month	744.00
	$7,126.00

This makes a decidedly different showing for the electric lighting account. If I am mistaken in my assumption I should be glad to be corrected.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—PRESIDENT NICHOLLS' INTERIM REPORT.

The following is the interim report issued by President Nicholls to the members of the National Electric Light Association:

When elected President of your Association, I fully realized that much useful work might be accomplished during the interval between conventions, and have earnestly endeavored since our last annual meting to initiate and, with the assistance of our Secretary, to conclude certain matters which I am hopeful will be approved of by our members, and upon which I now have the honor to report as follows:

Relations Between Manufacturing and Central Station Companies.—At our last Convention the Committee on Relations between Manufacturing and Central Station Companies was discharged, and the Executive Committee authorized to take such action as might, from time to time, be found necessary, in an endeavor to protect its active members from having their investments in central station companies destroyed, or seriously impaired, as a result of ruinous competition, directed or fostered by the manufacturing companies. At an early period of my administration such a case arose, in a western town, as justified prompt and energetic action on the part of your Association. After consultation with the members of the Executive Committee, I placed the views of our Association as to this particular case, and as to unwise and unwarranted competition in general, before the executive officers of the following manufacturing companies: Ball Electric Light Company, Brush Electric Company, Fort Wayne Electric Corporation, General Electric Company, Royal Electric Company, of Peoria, Siemens & Halske Electric Company, Stanley Electric Manufacturing Company, Western Electric Company, Westinghouse Electric and Manufacturing Company.

The details of our negotiations, by correspondence and in some cases by personal interview, are too voluminous to here set forth, but it is with much satisfaction that I am able to report that each of these companies, with the exception of the Ball Electric Light Company, has given favorable consideration to the representations made on behalf of your Association, and I have received, in writing, such satisfactory assurances regarding not only the particular case in question, but also as to their future general policy, that I am hopeful of good results. Should, however, any active member have reasonable cause for complaint, he should forward full corroborative details to our Secretary, and the Association will take prompt and energetic measures, if the circumstances warrant such action.

Municipal Lighting Statistics.—Being aware that no recent and reliable statistics of the cost of arc lighting in the cities and towns were available for use by members of the Association, I some time since instituted correspondence with the municipal authorities of each city and town in the United States, with the object of securing from official sources and by official authority reliable information from each place as to (1) the number of arc lamps, (2) their candle-power, (3) the hours of burning, (4) the cost per lamp per night. Accompanying this report you will receive, in pamphlet form, a preliminary bulletin, containing such information from over four hundred cities and towns, which list covers a very large majority of the principal installations. A supplementary list, containing similar information in regard to places now omitted, is in process of compilation, and will be issued to members at an early date. It frequently happens that when a contract is to be renewed, local papers publish very misleading figures concerning prices paid for arc lights in other municipalities, and as these statistics are of the months of June and July, 1896, they are reliable and up to date.

Laws Affecting Electrical Companies.—We have been in correspondence with the Secretaries of State for each of the States in the Union, with a view to making arrangements to have regularly forwarded to the Association copies of all bills introduced in any State that may deal with the rights of electrical companies. I am much pleased to be able to report that a large majority of the States have acceded to our request, and several have already forwarded copies of all bills passed during the past session of their legislature, while others have promised to forward any that may be introduced during future sessions. These will all be filed in the Secretary's office for the sole use and advantage of the members of the Association.

Revision of Constitution.—As the only printed copies of the Constitution and By-Laws of the Association did not contain recent additions and amendments, revised copies have been published, and may be obtained from the Secretary.

Report of Proceedings of Nineteenth Convention.—The report of the recent Convention, held in this city, is now in the prin-

ter's hands, and will be delivered to members not later than September 1, next. There has been some unavoidable delay, caused by speakers at the Convention failing to revise the stenographic copy of their remarks, but, so far as my memory serves, it will be issued much in advance of previous reports.

Improved Office Facilities.—The office of the Association being too small to be of service to our members visiting New York, the Chairman of the Finance Committee made arrangements to rent the adjoining office, with the special object of providing a room for the use of our out-of-town members. The office is centrally located in the down-town business district. Members can use this room for meetings, appointments, etc., and their letters and telegrams can be addressed here. As the records of the Association are increasing in number, two new book-cases have been provided, and already contain many books of reference.

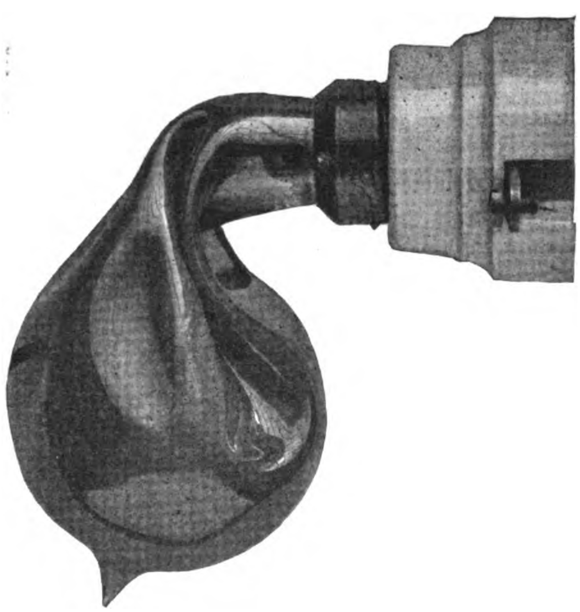
In conclusion, I wish to bear testimony to the zeal of our Secretary, without whose enthusiastic co-operation it would have been impossible to have accomplished so much in so short a time. I also have to request that members will aid me, by suggesting any action that may promote the welfare and add to the usefulness of the Association.

A PECULIAR LAMP ACCIDENT.

BY R. C. EDEN.

I HAVE a curio which you might like to put before your readers which started as a 20 candle-power, 110-volt incandescent lamp with a coiled filament, and was called upon to illuminate the fly gallery of a teutonic theatre. Here it fared wisely and well for some time; attached to the wall in horizontal position it shed its direct current light on carpenters and scene shifters, the good and the bad, impartially and efficiently.

But evil days were at hand, a "super" ignorant of the "laws



A PECULIAR LAMP ACCIDENT.

of the current," and Joule's equivalent, but possessing that perverted ingenuity which is bound to branch out in the wrong direction, was instructed (in German) to cut out this light. The switch, for this case made and provided, he could not or did not find, and here his aforesaid pervertible ingenuity took the road on the wrong track. Seizing a towel on which the remains of "make-up" and make-up grease were well in evidence, with a triumphant "Ach Gott, aber das ist ziemlich gut," he wrapped it round the lamp and descended to the stage.

The result was that the heat of the lamp so softened the glass of the bulb that from a horizontal it fell into a semi-vertical position and the glass coming in contact with the filament broke the latter. The cloth was badly scorched, but did not ignite. The lamp did not break, but is now of the shape shown in the illustration, with the glass much blackened, but intact.

A GAS EXHIBITION IN NEW YORK.

A Gas Exhibition will be held in New York at the Madison Square Garden during two weeks. The exact time has not yet been set, but it will probably be in January, 1897. Why not August?

ROENTGEN RAYS.

TECHNIQUE OF ROENTGEN PHOTOGRAPHY.

THE July number of the "Bulletin," of the electro-therapeutic laboratory of the University of Michigan, is devoted exclusively to Röntgen ray literature and contains, among other contributions, an article by Dr. W. J. Morton, explaining his modus operandi of taking X-ray pictures. Dr. Morton writes in part: "I use the static machine extensively for this work, but on the whole prefer the coil as more convenient and quicker. Both will do excellent work when properly managed. I put the tube in the circuit between the external armatures of Leyden jars in connection with each prime conductor. I use quite small jars. As the vacuum rises, larger jars may be required, and here comes danger, for the tube may break down. But the very high vacua are not essential to a good-working X-ray, and if the tube rises to an impracticable vacuum it should be heated freely with a spirit lamp until, upon passing current through it, the first faint tinge of blue appears at the anode, generally behind it. Now, as the vacuum gradually improves with use, a point will be reached in the history of the tube where it is doing its best work. That point may be judged of by the length of the spark gap between the discharging rods.

"As to coil, I believe only in the direct current as a source in the primary of the coil. A six-inch spark is good, an eight to ten or twelve is better, but a four-inch also will serve fairly well. What has evoluted out of confusion in my experiments is a coil (I use a twelve-inch), direct current from the 110-volt main, a break wheel, 8 breaks and 6,000 revolutions per minute, and the usual condenser. The strength of current to be used is entirely controlled by the vacuum in the tube. If this is low, little current can be used; if it is high, much current must be used. But the operator can, within reasonable limits, govern the situation. He must work with spirit lamp or Bunsen burner in hand. Also with his fluoroscope as a guide. A moderate current flowing steadily will steadily raise the vacuum. Watch the rise by adjustment of the discharging rods. A strong current will cause the vacuum to fall and the tube to heat at the cathode.

"This 'time of exposure' business is a wrong way to look at X-ray work, for one often spends fifteen to twenty minutes taking a picture, which is practically really taken by a very few minutes, or even few seconds, of those exceptionally brilliant moments all tubes have, for the vacuum in a tube never remains the same for half an hour—never, I believe, the same for one minute. I have taken an arm, wrist and hand in two seconds, but I took advantage of the two best seconds out of many more which I could get my tube to exhibit.

"What I have written applies only to present appliances and present methods as I now use them. A different Crookes tube, that is to say, one whose vacuum was not on a sliding scale, would change the tenor of many of my remarks."

EXPERIMENTS WITH CROOKES TUBES.

In a recent communication to the Academia dei Lincei, Prof. E. Villari describes some experiments carried out by him with Crookes tubes. He blew a mixture of sulphur and minium on to the glass of a tube at work. Generally there was a patch of minium coinciding with the fluorescent spot, the sulphur spreading uniformly over the rest of the tube. If the cathode rays were stopped by a sheet of platinum there was no red patch. The glass is thus negatively electrified just where the cathode rays impinge upon it, and is positively electrified everywhere else.

DISCHARGING EFFECTS OF ULTRA VIOLET RAYS.

At the Berlin Physical Society Professor Warburg maintained that the action of ultra-violet rays in facilitating sparking and the discharge of negatively electrified bodies consists in doing away with the retarding force which, according to Jaumann's researches, exists at each discharge. Gases unlike metals whose conductivity is independent of strength of current, only become conductors when the current has reached a certain intensity; hence possibly during the retardation the gas is becoming a conductor, and if so, the action of light consists in the removal of some obstruction to the establishment of conduction. All of which, if it comes to anything at all, only means that if a system in stress is just about to break down, any vibration accelerates the catastrophe. But really very little is known about it. Nor is it any answer to the ques-

tion why the effect is different on positive and negative charges, so far as ordinary ultra-violet light is concerned, while the Röntgen waves show no preference in the matter.

HOW TO PREPARE CALCIUM TUNGSTATE FOR X-RAY SCREENS.

BY C. E. TENNANT, M. D.

As the readers of The Electrical Engineer may be interested in the subject, I give the results of my recent experiments with the calcium tungstate. I find that the compound made after this manner gives the most satisfactory results of any fluorescent substance now known, especially on large screens, the size of the body, and these screens can be made for a price not to exceed twenty-five cents each, by any novice.

The spreading of the calcium tungstate evenly over the surface, offers the greatest difficulty, but with a little practice can be readily overcome.

To two parts of sodium tungstate add one part of calcium chloride; fuse the mass to a red heat. A resulting compound of calcium tungstate and sodium chloride is formed; this latter salt exerts active hydroscopic properties and as a result renders the calcium tungstate quite negative to the X-rays. But immersing the fused mass in water for an interval of forty-eight hours, disposes of the salt as is well known by its property of solubility while the insoluble calcium tungstate remains a precipitate. This latter is now separated by filtration and when dry assumes a crystalline formation and is very sensitive to the X-rays.

An amorphous preparation of calcium tungstate may be obtained by adding a saturated solution of sodium tungstate to a solution of calcium chloride, which results in the precipitation of the calcium tungstate, but this amorphous crystalline form is absolutely worthless for use with the X-rays.

THE X-RAY IN INTESTINAL INVESTIGATIONS.

Mr. Wolf Becher, practicing physician in Berlin, Germany, writes in the German "Medicinische Woehenschrift" as follows: In April of this year I showed that the stomach of guinea pigs may be photographed by the Röntgen method if solutions of lead salts are injected into the intestines. The process is possible since not only metals but also their salts are opaque to the X-ray. Almost the least opaque of all organic substances, are the bones. This fact induced me to test phosphate of lime and also other lime compounds in regard to their transparency for Röntgen rays. It was found that lime water has a great tendency to absorb the rays. This determination is of interest in connection with the work of G. Hoppe-Seyler on radial arteries and E. Grummach on the coronar arteries of the heart which showed that arterio sclerotic changes in the human being can be observed by the Röntgen method.

Another method besides the injection of salts may be utilized to make the stomach visible, that is, by inflating air into the stomach. On a Röntgen photograph of a guinea pig, whose stomach was inflated with air shortly before its death, the larger part of the stomach is visible. There is a considerable difference between the Röntgen ray photography of the early days and now, inasmuch as the apparatus has since been considerably improved. On the photographic plates a great deal more is visible to-day than there was formerly. A picture of the guinea pig is very instructing indeed. We observe in the first place the entire skeleton and in the thorax we can observe not only the bony, but also the cartilaginous parts. Muscles and bones vary, however, in the density of the shadow thrown. In the thorax the lungs appear particularly bright. In the middle of the light field the heart can be discerned. The diaphragm which separates the chest from the stomach is plainly visible. Under the left side of the diaphragm the strongly inflated stomach, can be seen, reaching to the last rib. In the upper part the rather dark liver can be observed. In about the middle of the abdomen the intestines can be seen in contours. At the left of the spinal column, about the height of the last rib a round spot might, according to form and position as well as color, be diagnosed as the left kidney. The successful operations on the animals make us very hopeful that the Röntgen process may turn out to be extremely useful with the increasing improvements of the technical details.

POWER TRANSMISSION.

TRANSMISSION AT RHEINFELDEN.[1]

BY E. RATHNAN.

As early as 1889 the Allgemeine Elektrizitäts-Gesellschaft investigated the advisability of power transmission at Rheinfelden. The investigating committee had to confer with the various states surrounding the district, and the most interesting condition was the demand of leaving in the bed of the river a quantity of water at any time of at least 50 cubic metres. According to the report of Professor Intze, who was retained as consulting engineer, the effective horse-power did not exceed 13,800 at the turbine; this being a low and satisfactory estimate the "Transmission Works Rheinfelden" were founded with a capital of four million marks.

Twenty turbines of 840 horse-power each were planned, and at the end of the upper canal a corresponding number of chambers are constructed to serve for the motor installation. These chambers are 5.5 metres wide, 10 metres long and are separated by walls 1.25 metres thick. Arrangements are made to absolutely remove water from these chambers if repairs or inspections require it. The dynamo rooms will have a width of about 10 metres and a length of over 150 metres, thus extending over all turbine chambers. Rails and wagon paths lead from the dynamo room to the shore on one side and a bridge will be built across the river to connect the two shores.

The Francis turbines, Fig. 1, have two working wheels and

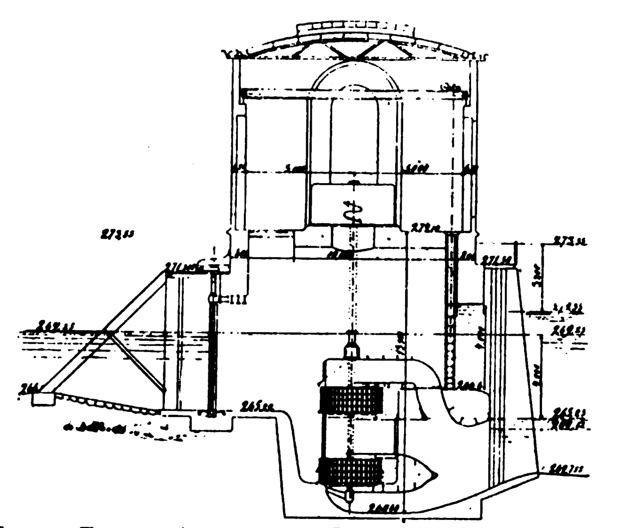


FIG. I.—TURBINE ARRANGEMENT, RHEINFELDEN TRANSMISSION.

two guide buckets, but inasmuch as the water runs out in two directions from every working wheel, they might as well be considered as quadruple turbines. In consequence of direct coupling of the dynamos to the shafts of the turbines, instead of toothed gearing transmission as was first proposed, and owing to the better introduction of the water through the upper canal, the gain in useful energy will be about 2,000 horse-power. It should be mentioned that the maximum efficiency can only be expected if the fall is considerable, while when the river runs high the somewhat greater amount of water used cuts no figure.

The turbines used consist of two pairs of wheels of 2,350 mm. opening, and 1,240 mm. high. The turbines are reaction wheels, each working section containing 32 and each conducting section containing 36 buckets. The mean distance between two turbines is 3,370 mm. The turbines have an efficiency of 75 per cent.

The electrical part of the installation was given most careful study. The problem was to distribute over a considerable distance with small losses and cheap distributing network; the various consumer's premises had to be independent and the current system had to be such as to serve for lighting, heating, electrolytic work and power transmission. Since no such ideal system exists, it remained to choose between the direct current, single phase and multiphase.

After long considerations it was decided to adopt three-phase current at 50 periods per second, since with that number drop due to self-induction may be kept low. For transformers, motors and incandescent lamps this method is well adapted

[1] Abstract of a paper read before the Verband Deutsch Elektrotechn.

and also permissible for arc lamps, if the requirements for steadiness are not exaggerated.

To determine the most suitable voltage many investigations had to be made. On the assumption of a network of 20 kilometres radius and considering cost of generators, transformers, measuring and regulating apparatus, 16,500 volts was considered the most suitable.

Since the demand for electrical energy grows only gradually, it was decided to work in the beginning with 6,800 volts, which is the voltage of the generators. The type of generator used, Fig. 2, has revolving pole pieces, because these machines allow of the adoption of a great many poles of comparatively small diameter, and the generation of the field without too large a mass of copper. In principle these machines consist of two stationary, mechanically and magnetically connected armatures; they are built up of laminated iron sheets and carry on their projecting teeth the spools which have micanite insulation.

The induction ring which consists of five sections is connected with the shaft by means of a spider and has 55 poles on its circumference, the ends of which consist also of laminated iron sheets, and which close the magnetic circuit between the two armatures so that during the revolution of the pole piece the section of highest magnetic density travels along the surface of the two armatures, thus acting inductively on the armature spools. In order to relieve the weight of the shaft, oil is introduced under pressure. Magnetic leakage is avoided as much as possible by the introduction of sections of bronze.

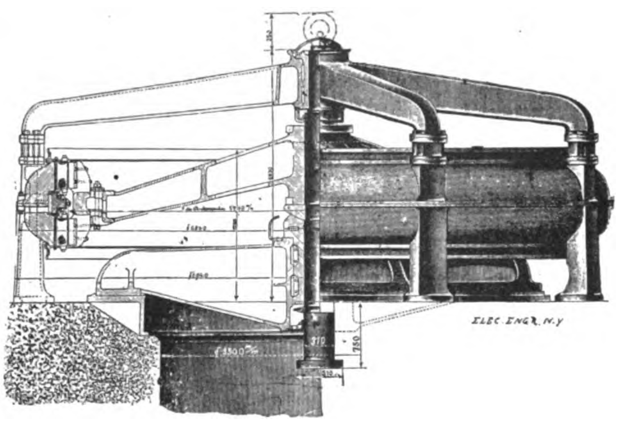


FIG. 2.—THREE-PHASE DYNAMO, RHEINFELDEN POWER TRANSMISSION.

The normal capacity of each dynamo is 63 amperes with 3,800 volts per phase, and thus furnishes 720 kilowatt. Under an assumed lag in consequence of the motors up to cos. b = .8 this capacity would be reduced to about 580 kilowatts, thus requiring about 840 horse-power at the shaft.

The total efficiency is above 92 per cent. Although no dangerous overheating is expected, considerable attention has been paid to ventilation. Since lighting and power service will be permanently kept apart, four dynamos will be used for the first and fourteen generators for the latter; half of these will be devoted to the chemical industries. In case of exceptional consumption, in which the two reserve dynamos are not sufficient, the lighting and power circuits may be combined.

The transformers, which are to raise the voltage to 16,500 will be put up in a separate room later on. Three rectifiers will be installed to generate direct current for the charging of a small plant of accumulators which is to do service on Sundays.

The scale of prices commences with 40 pfennig per kilowatt hour, and the rebate goes as high as 80 per cent. for large consumers. For power the price per kilowatt hour will be 1.6 pfennig (.4 cent.).

POWER FROM THE NIAGARA RAPIDS.

It is announced that there is every prospect of a new power company being incorporated at Niagara to develop the power of the Rapids from the current along the Gorge Road. The company owning this road control the New York State bank of the lower river for a distance of over six miles, along the full extent of which there is a rapid current.

While the franchise now held by the company does not empower them to develop and sell power an incorporation might be formed having such power. Already two attempts at developing the power of the current have been made and both plants, of a crude nature, were swept away by high water.

A ROTARY FIELD MOTOR FOR LECTURE PURPOSES.[1]

BY ALBERT F. GANZ, M. E. INSTRUCTOR IN APPLIED ELECTRICITY, STEVENS INSTITUTE.

Description of Motor.—A general view of this motor, which was briefly mentioned in the last number of the "Indicator," is shown in Fig. 1. It was constructed in the electrical laboratory of the Institute, with a view of obtaining a simple piece of apparatus for illustrating the principles of rotating magnetic fields, as embodied in commercial induction motors. The model has proved so generally useful that a brief description of it, together with a simple explanation of the theory involved, may be of interest[2].

The model consists essentially of a laminated ring electromagnet of square cross-section, having a mean diameter of 27.5 centimeters and sectional area of 18.4 square centimeters. This ring is divided into twelve equal parts by radial flanges, and each part is wound with 140 turns of No. 14 B & S wire; the ends of each coil are brought to separate binding posts on the base of the model. By this arrangement the coils can be grouped in any manner desired.

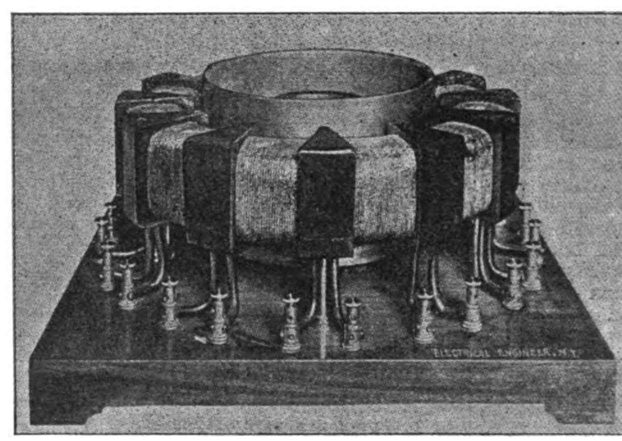


FIG. 1.—ROTARY FIELD MOTOR FOR LECTURE PURPOSES.

In the center of this ring, and just below it, is a brass disc free to rotate. Fig. 2 shows a cross-section of the bearing; it consists of a vertical steel shaft (A) running in a brass bearing (B), together with a pair of steel discs (C) separated by steel balls placed in suitable grooves and forming a horizontal ball bearing. The brass disc (D) is a sort of turntable upon which the masses of metal, armatures, or rotors generally, with which we wish to experiment, may be laid or suitably fastened. The weight of the rotating mass is thus supported by the steel balls, reducing friction to a minimum[2].

Production of Rotating Fields.—The simplest rotating field is produced by revolving an ordinary horse shoe magnet about an axis pasing midway between the poles. By taking a number of magnets, with their poles alternately N and S, we can produce a multipolar rotating field. If a disc of copper or iron is pivoted in the axis of rotation and placed near such a magnet, it will be dragged around with the rotating field, due to the eddy currents induced in the disc. Such rotations have long been known under the name of Arago's rotations.

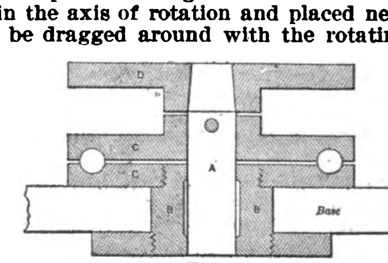


FIG. 2.

Such traveling poles can also be produced by the proper combination of alternating currents, differing from each other in phase. At least two such currents are necessary, in which particular case the phase difference should be 90 degrees. Such are the ordinary two-phase currents, graphically represented in Fig. 3. One method of connecting the coils for two-phase currents is shown in the diagram, Fig. 4. At one particular instant, marked 0° in Fig. 3, the current in A is a maximum, and that in B zero, so that the resultant magnetization is that

1 "Stevens Indicator."

2 For a complete analytical treatment of the subject see "Polyphase Electric Currents," by S. P. Thompson.

due to A alone. If the ring were cut in two across a diameter C-D, coils G, on one half of the ring, would produce the poles n and s; coils H, on the other half, the poles n' and s'. When both coils are active, as they really are, the ring can be joined again and the resulting poles will be at N and S. The general direction of the lines of force at this instant is shown in Fig. 5.

One quarter-period later, marked 90° in Fig. 3, the current in A is zero and that in B a maximum, so that the magnetization at this instant is that due to B alone, bringing the resultant poles to N' and S'. At a time half-way between these two, marked 45° in Fig. 3, both set of coils are equally active. G

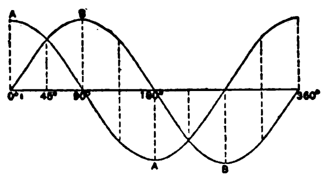


FIG. 3.

and H tend to produce poles at N and S, while C and D, such at N' and S'. The resultant poles will therefore be midway between or at E and F. The same reasoning would show that at any intermediate time the resultant poles would be at corresponding intermediate points.

One half-period after the first instant considered, marked 180° in Fig. 3, the current in B is zero and that in A has reversed and is again a maximum; the poles will therefore be N and S reversed. Another quarter-period later the poles are N' and S' reversed, and at the end of a complete period the poles have made one complete revolution.

In fact, if the two currents are of equal period and amplitude and differ by exactly quarter of a period, the resultant field has a constant value, and rotates with a uniform angular velocity. Three equal currents, differing by 120 degrees, applied to three coils placed symmetrically will also produce a resultant constant rotating field[3]. Or, in general, any number of equal currents of as many phases may be applied to as many symmetrical coils with the same result. A pivoted magnet placed inside of this ring would be dragged around in synchronism with the revolving poles, and would make a synchronous multiphase motor.

The paths of the lines of force for one instant are shown in Fig. 5; they are seen to stream across the interior of the ring, and, as explained above, this system of magnetic lines rotates about the axis of the ring at a rate corresponding to the frequency of the alternating current.

Suppose now that we place a mass of metal inside of the ring; this is usually known as the rotor; the lines of force, rotating about the axis, evidently cut this mass of metal and set up in it electromotive forces, and these in turn produce currents. The general direction of these currents is found by applying Fleming's three-finger rule, using the right hand; it must be borne in mind that we have to assume the rotor to revolve and the lines to remain fixed when applying the rule. The general direction of currents at z will be towards the reader, and at w away from the reader perpendicular to the plane of the paper; now these currents

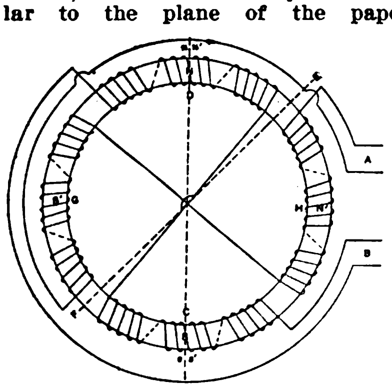


FIG. 4.

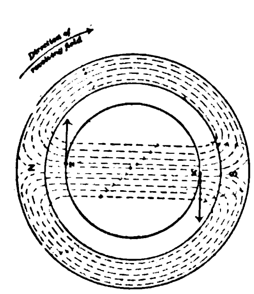


FIG. 5.

are in a magnetic field, and consequently the rotor, carrying the currents, experiences forces tending to move it. To find the direction of these forces, we apply Fleming's three-finger rule for motors, using the left hand; it will be found that these forces at z and w are in opposite directions, and produce a couple in the direction of the rotating magnetic field. If our rotor is pivoted it will be set into rotation in the direction of the revolving field. Very good results were obtained with an ordinary iron pulley, shown in the illustration, Fig. 1.

[3] For an analytical proof of this see "Polyphase Electric Currents," page 63.

The magnitude of the couple varies as the square of the number of lines of force; for, if this number is doubled, the current induced in the metal is also doubled, so that the force between the two is quadrupled. For a given magnetizing current, the flux depends directly on the goodness of the magnetic circuit; and since the space inside of the ring always forms part of this circuit, the flux will be increased by introducing iron into this space.

The currents induced depend upon the rate of cutting of the lines of force; this rate is greatest when the rotor is fixed, and decreases as it begins to revolve, finally becoming zero if its speed of rotation should become that of the magnetic field. The difference between the angular velocities of field and rotor is called, by S. P. Thompson, the slip; the cutting of lines, and therefore the induced currents, are due to this slip; and since the rotation is produced by these induced currents, there must always be some slip. That is, such a motor cannot run in synchronism with the rotating field.

Instead of producing simply two traveling poles, we can so connect our coils as to produce a number of such poles. The diagram, Fig. 6, shows the connections for producing six traveling poles by means of two-phase currents. The capitals N and S indicate the positions of the poles at one instant when the current in B is a maximum; one quarter-period later these poles have shifted to the positions indicated by the small letters n and s—that is, through 30 degrees. We thus have a multipolar rotating field, the number of rotations of the field being equal to one-third the frequency of the alternating-current supply. This method of connecting therefore affords a means of obtaining slow speeds. By increasing the number of poles, we decrease the number of revolutions of the rotor in the inverse ratio.

Closed Coil Armatures.—So far we have only spoken of

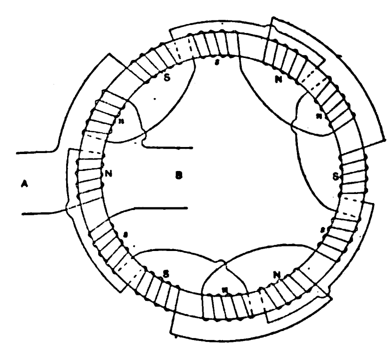


FIG. 6.

masses of metal to be used as rotors; the general direction of induced currents in such masses of metal will be as has been shown above. But some of the currents will not flow in the proper direction to help produce motion, and such currents will be wasted. To avoid this waste, we must restrict the induced currents to flow in directions in which they can do useful work, which direction is parallel to the axis. This is accomplished by winding conductors upon a core and so connecting these conductors that the current flowing upward near one pole returns downward near an opposite pole. In the case of the bi-polar type this would be across a diameter; in the six-pole winding mentioned, the span would be 60 degrees. A number of closed circuits would thus be established in which the induced currents would flow in directions proper for producing rotation. Another very common form of connecting these conductors together is that known as the squirrel-cage construction. This consists in connecting together all the conductors on each end by means of a ring. Such an armature will run in any rotary field. For our model we constructed a squirrel-cage armature by making a cylinder of sheet copper and cutting into this a number of slots parallel to the axis of the cylinder.

The core is ordinarily made of soft iron, laminated in a direction perpendicular to the axis. At the moment of starting, the induced currents are very large; the effect of this is to partially neutralize the magnetizing effect of the field coils, which will then draw very large currents from the supply. To avoid this a starting resistance is introduced. Since the secondary circuits have inductance, there is always a lag between the secondary currents and induced electromotive forces, and consequently also between the primary and secondary currents. This is an important matter in the design of these motors.

Several other uses of the model may be mentioned as matters of curiosity. The field magnet by itself can be used as a static transformer, with a variety of ratios. S. P. Thompson's method of phase transformation can also be illustrated; for this

purpose all coils are connected in series. If two phase currents are supplied to four symmetrical points on this series, three-phase currents can be drawn from three symmetrical points on the series; or vice versa. This is a very striking experiment.

Besides the few methods of connection for producing rotary fields, already mentioned, a number of other methods may be used, some of which will readily suggest themselves.

Reversing Induction Motors.—It has been shown that the rotor follows the direction of rotation of the revolving field. So to reverse the direction of the rotor we must reverse the rotation of the magnetic field. In the two-phase system this is effected by interchanging the wires of one circuit, so that, if continuous currents were used, the direction of the current would be reversed in one set of coils. In the three-phase system, using three wires, the reversal is effected by interchanging any two of the three wires.

ELECTRICAL TESTS OF POWER REQUIRED BY WOOD-WORKING MACHINERY AT THE NAVY YARD, WASHINGTON, D. C.[1]

In the case of the following tests, the mechanical horse-power delivered by the motor was determined by tests made under the same conditions as the previous power tests. This was necessary, as in many cases long leads were run to the motor and the drop was large. In other cases it was necessary to use a rheostat in series with the armature to obtain the required speed. Under these conditions the efficiency of the motor was a very variable factor, and a separate test was made in each case to determine the output of the motor. The column of mechanical output is therefore the proper one to use in determining the motor required, and the electrical horse-power to be delivered by the generator.

The work done is the heaviest that will be required of these particular machines:

Circular rip saw, 28 inches diameter; speed, 1,200 revolutions per minute, or 8,800 lineal feet per minute. Arbor pulley 5¼ inches diameter by 8½-inch face; hand feed; motor belted to saw shaft: Motor and saw, idle, 3.4 e. h. p.; ripping seasoned heart oak, 7⅝ inches thick; feed, 10 feet per minute, 19.3 e. h. p.

Circular rip saw, 24 inches diameter; speed, 1,500 revolutions per minute, or 9,429 lineal feet per minute; hand feed; motor belted direct to 7-inch pulley on saw shaft: Motor driving saw, idle, 3.2 e. h. p.; ripping seasoned heart oak, 6 inches thick, 10 feet per minute, 12.8 e. h. p.; ripping seasoned white pine, 6½ inches thick, 15 feet per minute, 9.4 e. h. p.; ripping seasoned yellow pine, two inches thick, 45 feet per minute, 10.7 e. h. p.

Circular rip saw, 14 inches diameter; speed, 2,200 revolutions per minute, or 8,067 lineal feet per minute; Arbor pulley, 3 inches diameter, 5 inch face; hand feed; motor belted to saw shaft: Motor, idle, .96 e. h. p.; motor and saw, idle, 2.7 e. h. p.; ripping seasoned heart oak, 3½ inches thick, 12 feet per minute, 6.3 e. h. p.

Circular rip saw, 12 inches diameter; speed, 2,200 revolutions per minute, or 6.914 lineal feet per minute; hand feed; belt pulley 3½ inches diameter and 3-inch face; motor belted direct to 3½-inch pulley on saw shaft; saw set to wabble for cutting grooves: Motor, idle, .96 e. h. p.; driving saw, idle, 2.2 e. h. p.; cutting groove in seasoned walnut, ⅜ x ⅞ inches, 12 feet per minute, 3.6 e. h. p.

Band saw pulleys 72 inches diameter; speed, 160 revolutions per minute, or 3,017 lineal feet per minute; belt pulley 30 inches diameter, 8-inch face, power feed; motor belted to saw shaft: Motor and saw, idle, 12.1 e. h. p.; ripping seasoned ash, 10¾ inches thick, feed 6 feet per minute, 16.1 e. h. p.; ripping seasoned white pine, 16½ inches thick, feed 10 feet per minute, 16.1 e. h. p.; ripping yellow pine, 12 inches thick, 20 feet per minute, 18.8 e. h. p.

Band saw, pulleys 42 inches diameter; speed 350 revolutions per minute or 3,850 lineal feet per minute; belt pulley 16 inches diameter, 5-inch face; hand feed; motor belted to saw shaft: Motor, idle, .96 e. h. p.; Motor and saw, idle, 2.9 e. h. p.; ripping seasoned oak, 12 inches thick, feed 3 feet per minute, 5.7 e. h. p.; cross-cutting seasoned oak, 8 inches thick, feed 5 feet per minute, 5.7 e. h. p.; ripping live oak, 10 inches thick, feed 3.2 feet per minute, 5.7 e. h. p.

Band saw pulleys, 28 inches diameter; speed 480 revolutions per minute, or 3,520 lineal feet per minute; belt pulley 12 inches diameter, 3½-inch face; hand feed; motor belted to saw shaft: Motor, idle, .96 e. h. p.; motor and saw, idle, 1.7 e. h. p.; ripping seasoned oak, 3 inches thick, feed 2½ feet per minute, 2.3 e. h. p.; ripping seasoned pine, 3 inches thick, feed 4 feet per minute, 2.3 e. h. p.; cross-cut seasoned oak, 3¼ inches thick, feed 4 feet per minute, 2.3 e. h. p.

Daniel's planer, machine bed 2 feet 5 inches by 21 feet 6 inches; belt pulley 13 inches diameter by 5¼-inch face; speed 350 revolutions per minute; speed of cutting edges of tool 10,400 feet per minute; power feed 12 feet per minute; motor belted to countershaft: Motor, idle, .96 e. h. p.; driving machine, idle, 3.9 e. h. p.; planing seasoned oak, cut 3-16 inch deep by 20 inches wide, 12 feet per minute, 6.2 e. h. p.

Hand cylinder planer or jointer, size of machine 24 inches; belt pulley 4 inches diameter, 5-inch face; speed 3,200 revolutions per minute; speed of cutting edge of tool 4,000 feet per minute; hand feed; motor belted to shaft of tool: Motor, idle, .96 e. h. p.; driving machine, idle, 2.40 e. h. p.; planing white pine, cut 11-100 inch deep by 18 inches wide, 25 feet per minute, 4.80 e. h. p.

Cylinder planer, size of machine 24 inches; belt pulley 5 inches diameter, 5-inch face; 2,250 revolutions per minute; speed of cutting edges of tool 3,105 feet per minute; power feed; motor belted to shaft of tool: Motor, idle, .96 e. h. p.; driving machine, idle, 2.40 e. h. p.; planing pine, cut 1-16 inch deep, 18 inches wide, 11 feet per minute, 3.6 e. h. p.; planing oak, cut 1-16 inch deep, 6½ inches wide, 11 feet per minute, 3.6 e. h. p.

Boring machine, speed of bit 375 revolutions per minute; hand feed; motor belted to bit shaft: Motor, idle .96 e. h. p.; driving machine, idle, 1.7 e. h. p.; Boring, 4-inch hole in seasoned oak, 9 3-5 feet per minute, 2.3 e. h. p.

Boring machine, belt pulley 8 inches diameter, 3-inch face; speed 750 revolutions per minute; hand feed; motor belted to machine shaft: Motor, idle, .96 e. h. p.; driving machine, idle, 1.9 e. h. p.; boring 1-inch hole in oak, feed 3¾ inches in 5 seconds, 2.2 e. h. p.; boring 1⅝-inch hole in oak, feed 1 inch in 7 seconds, 2.2 e. h. p.

Pattern makers' lathe, speed 888 revolutions per minute; motor belted direct to lathe: Motor, idle, .96 e. h. p.; driving lathe, idle, 2 e. h. p.; turning seasoned poplar, 12 inches diameter, ½ inch cut, 3.2 e. h. p.

Carver and molder, speed of tool 5,236 revolutions per minute; motor belted direct to tool shaft: Motor, idle, .96 e. h. p.; driving tool, idle, 2.8 e. h. p.; cutting groove, circular sector, 2 inches wide, ¾ inch deep, 3½ feet per minute, in white pine, 3.9 e. h. p.

[1] Reported by Prof. O. G. Dodge, U. S. N.

MONSTER ELECTRIC ELEVATOR AT ALLEGHENY, PA.

Electricity is to be used to furnish motive power for a monster elevator which it is proposed to erect in the lower part of Allegheny. The only way the people have of getting from McClure avenue to California avenue is by a one and one-quarter-mile trip, and yet these two points are separated from each other by a distance of only 150 feet. A company is now being organized to build an elevator from McClure to California avenues. It will be sufficiently large to carry several wagons and a number of passengers at once. It will be run by electricity. At the head of the scheme are Lewis Mathews, of McClure avenue; John Wall, of the Wall Manufacturing Company; Christopher Becker, a butcher of McClure avenue, and John Rising, a druggist on the same street. It will cost about $25,000 to construct the elevator.

AN ELECTRIC SWUNG BRIDGE.

The new highway bridge across the Connecticut River connecting Middletown with Portland, Conn., is now swung by electricity. The electrical equipment consists of four G. E. 800 horse-power motors. Two of these are connected with the swinging mechanism, one working and the other being held in reserve. Of the other two, one is located under each end of the turning span, to raise it from the fixed piers before the third motor begins to swing it. The bridge span is 450 feet long, the longest single-span highway bridge in the world. Previous to the installation of this electrical equipment by the General Electric Company, fifteen men were required to start the bridge and eight men to swing it.

ELECTRICITY IN NAVAL WORK.

At the recent meeting of the Institution of Naval Architects in Berlin, Herr Dietrich, Constructor-in-Chief of the Imperial Germany Navy, read a paper on the development in design and construction of German men-of-war. He thought England might with advantage copy Germany in employing electricity as much as possible instead of steam. The German Admiralty found that the only way to get rid of the heat from numerous steam pipes was to do away with them. By the use of electricity the conducting wire took the place of the steam pipe, and the ships were rendered more healthy as well as safer in action. All new German warships have electricity as the motive power for ventilating fans, turning gear of gun turrets, ammunition hoists, coaling winches, and such purposes. In the discussion which followed it was noticeable that Herr Dietrich's paper had made a great impression on the English

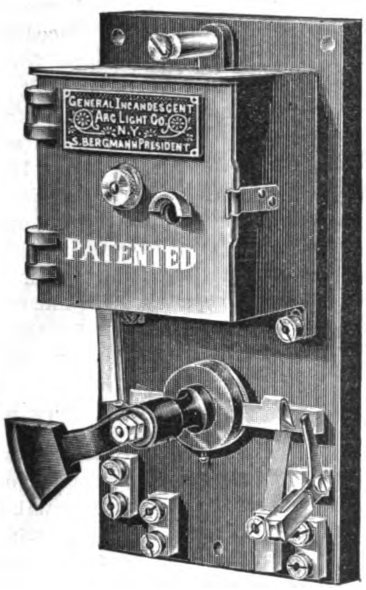
part of his audience, and there was a desire felt that his remarks on the further employment of electricity should be recommended to the notice of the English Admiralty.

LETTERS TO THE EDITOR.

CLOCK SWITCH FOR LOW TENSION ARC LAMPS.

We are interested in an article published in your edition of July 15, reprinted from the London "Electrical Review," entitled, "Public Art Lighting on Motor Generator and Battery System," which calls attention to the desirability of a clock switch for low tension arc lamps.

We desire to state that we have been manufacturing such clock switches for some time. These switches, which are illustrated in the accompanying cut, operate automatically both to turn on current at whatever hour of the day the dial



CLOCK SWITCH FOR LOW TENSION ARC LAMPS.

is set for, and also to cut it off again at any desired time. The trimmer attends to the setting of the switch and winding of the clock at the same time that he trims the lamps, and second and third trips for switching the lamps on and off are saved by its use.

These clock switches have been in regular use on the municipal arc light circuits of the Edison Electric Illuminating Company of Brooklyn for some time, and have recently been installed for the same work of the Edison Electric Illuminating Company of New York, and a number of them are in use by companies in other cities; but the companies first named will be sufficient reference regarding the success attending their use and that the saving in operating expense is considerable and amounts to more than the first cost each year.

GENERAL INCANDESCENT ARC LIGHT CO.

New York, July 22, 1896.

THE SOUTH HAVEN, MICH., MUNICIPAL PLANT.

In your issue of July 29 there appeared an article headed "Mistakes of Municipal Control," with a footnote as follows: "Facts and figures presented to the citizens of St. Joseph, Mich., by Mr. W. Worth Bean, President St. Joseph and Benton Harbor Electric Railway and Light Co. (After thorough investigation the municipal plant idea was abandoned and a contract made with the company.—Eds. E. E.)"

It is not my desire or intention to enter into a controversy with the author of that article or anyone else on the merits or demerits of municipal ownership of electric lighting plants,but I feel that the article in question does an injustice to the business tact of our village officials, who are all responsible business men, and in a certain degree, to myself as electrician.

Mr. Bean is known as an enemy of the municipal ownership of anything, and electric light plants in particular, and would naturally desire under the circumstances which caused him to make that report, to make a poor showing for our plant. He took for the basis of his report the first six months from date of installation, which would, you will agree, be an unfair criterion. We have since that time substituted coal for oil, making thereby a reduction of nearly one-half in our fuel bill. We are carrying twenty amperes on our alternator, which is 2,000 volts primary and 1,000 light capacity, and forty-two arc lights on our 50 light machine.

Mr. Bean did not spend over five minutes in conversation with me on the subject of our plant, about the same length of time with the engineer relative to the waterworks, and possibly thirty minutes with the village president on both subjects. He did not examine the books of the village clerk to verify his statements regarding the number of customers, and his report is about as correct as could be expected from anyone giving the subject the same amount of time.

After returning to St. Joseph he wired our village clerk to this effect: "Write me giving expense account of operating your electric light plant, also receipt for same and I will tell you whether your plant is paying expenses or not." It is needless to say his telegram went into the waste paper basket.

In conclusion I will say if the Board of Public Works in St. Joseph decided to abandon the municipal plant idea on the strength of Mr. Bean's report of our plant, they certainly showed a nervous haste in so doing, and if they will send a committee here to make an impartial investigation, we will convince them that they made a mistake.

L. A. BRIDGES,

South Haven, Mich. Electrician and Superintendent.

NEWS AND NOTES.

USE OF ACCUMULATORS WITH ALTERNATE CURRENT.

The night load at the central station lighting Zürich being near the maximum output of the station, and the street mains, moreover, not being adequate for dealing with much heavier currents than those employed at the time, it was decided, when current was required for a large new music hall, to light the same by means of direct currents from accumulators, says the "Electrotechnische Zeitschrift." These accumulators are charged during the day by means of rectified alternate currents, so that, in addition to relieving the night load, the day load is increased, and thus much more favorable conditions obtained for the economical working of the station. The consumption of current at this music hall (the "Neue Tonhalle") is equivalent to 2,000 16-candle-power lamps. The plant is installed in the cellars of the Neue Tonhalle, and comprises a battery of accumulators, two current rectifiers, the switches, and measuring arrangements. Moreover, in view of the novelty of the arrangement, an alternate to continuous-current transformer was put in as a reserve.

CONDITION OF MOSCOW STUDENTS.

The reply of the students of Moscow to the invitation of the students of Glasgow University to take part in the Kelvin Jubilee, has not, says an exchange, received the attention from the press that it deserved, especially as the Russian youths requested their Glasgow would-be hosts "to do our letter as much as possible notorious." The communication is very quaint. Here, for instance, is a passage which shows the conditions under which learning is acquired in Moscow: "It (the 'common administration') raises against us the less civilized classes of the population as against men evil-minded and rioters, it surrounds us by spies, unseldom concealed under our 'academic dress,' sometimes even it sends in our middle provocators. We are even subjected to searches, the most active from us undergo administrative chastisements—they lose their liberty and sometimes for some years are send out from the cities having a university, what for many attracts the impossibility of ending their education and following the chosen career. Many intelligent and energetic men are perished by this police regime with all his discretion. . . . You see now, it is for us quite impossible to send any delegates; every person, sended by us, would undergo a too hard punishment. We salute, nevertheless, your professor, whose scientific merits are known to all the world, and we express our profound regret that we have no possibility of taking a more active part in the life of the Western intelligency, sympathy of which and the greatest possible connexion with which cannot but be to us very desirable." The letter, which had been sent under cover to Berlin, and there registered before being posted, is signed by the "Moscow Federative Council of the 45 United Zemljachestva of Moscow."

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CONTENTS.

THERAPEUTICAL EFFECTS OF HIGH FREQUENCY CURRENTS.

THE therapeutical effects of high frequency currents are being investigated by D'Arsonval in a scientific manner which promises results whose accuracy will be of the greatest value. He has already demonstrated that currents of this nature have a powerful effect on organic composition, and in another column we print a preliminary report of some very exact experiments in this direction, which are being undertaken in Paris under his initiative. One noticeable point about these experiments is the extreme care which has been taken to secure accuracy in his results and to eliminate any possible source of error which might arise through the imagination of the patients. In his own words "every precaution was taken to give these observations a character of precision which should give them value." Another point of interest is the unusually large amount of current which was administered to the patients and which, it appears, produced no effect upon their sensibilities. In these experiments from 350 to 450 milliamperes were used, which is an amount unthought of in the case of the application of ordinary currents. The reason why such currents produce no effect on the sensibilities of patients is still a matter of conjecture, but D'Arsonval has proved very conclusively that it is not for the generally accepted reason that currents of this nature are distributed superficially over the body. On the contrary he believes that these currents penetrate the body deeply, as they operate noticeably on the vaso-motor centers. We must therefore look for some physiological reason to account for the harmlessness of currents of high frequency to the human body.

SAFETY FUSES AND MAGNETIC CIRCUIT-BREAKERS.

DURING the past few years much has been written on the subject of safety fuses for the protection of electric circuits carrying heavy currents and it may now be fairly taken to be the consensus of opinion among those who are entitled to speak on the subject, that, except for branch circuits of comparatively small carrying capacity, the safety fuse is not only inadequate but may even constitute an element of danger under certain circumstances. These dangers are due to two general causes: First, the lack of dependence to be placed on the fuse blowing at the current for which it is intended; and second, that due to the generally prevalent practice of designedly inserting fuses of greater carrying capacity than the circuit is intended to carry for the very purpose of enabling the circuit to carry an overload either temporarily or permanently, and thus to obviate the "trouble" of inserting a fresh fuse. To what extent the latter practice has spread not only here, but abroad, is made apparent by the recent prize competition instituted in Germany for a "non-interchangeable" fuse which shall make the insertion of an improper fuse impossible. These manifest defects of the fuse have recently led to a more general adoption of the magnetic cut-out or circuit-breaker. It is probably due largely to the excellent work of this type of protector in the railway field that its present employment in lighting is due, and the practice is to be commended in every

way. But recently another phase of this subject has forced itself to the front, which must be taken into account, and which affects directly the operation of central stations for lighting and power. This is the tendency and, indeed, practice of discarding altogether the use of safety devices in the station and trusting to luck, or, in the end, pocketing the loss of an armature burnt out. The justification for this procedure is found in the desire to prevent at all hazards an interruption of the service, such as would be caused by the blowing of a fuse or the tripping of a circuit breaker, some station managers believing it to be more economical in the end to repair an armature than to answer complaints of lights out and motors stopped. The question here raised is a nice one and as to whether the practice is worthy of adoption is one which each station manager will have to decide for himself. But is there not some method of operation which will prevent a burn-out and still maintain the integrity of the circuit? It would seem that there is, and that a proper relationship between engine and dynamo may indeed make the station safety device of minor importance. It is this method of attacking the problem that Mr. William Baxter, Jr., discusses in another column and which we think deserves the most serious consideration, not only from the standpoint of tne cut-out and interruption of the service alone, but from the general economy of installation and operation. It will thus be seen that the last word has by no means been said on the question of circuit protection within the station, and that it involves problems far beyond the mere choice of the type of protector. In view of the importance of the subject we shall be glad to open our columns to the expression of opinions by our readers.

THE FINANCIAL ASPECT OF THE ELECTRICAL BUSINESS.

EVERYONE connected with the manufacturing side of the electrical industry is fully aware that the financial results of the business have been very unsatisfactory in the case of almost all of the large manufacturing concerns; and this is in spite of the enormous growth of the business and the almost universal adoption of electrical machinery.

There have been a number of fundamental troubles, mostly of the nature of extravagance, which are slowly being eliminated from this business. A number of these troubles are pointed out in an article in the "Engineering Magazine," by Mr. B. E. Greene, who believes that a new order of things is about to be established, and that the business will shortly take its place among the stable and substantial industries of the country.

One of the most serious losses of money has been the cost of patent litigation. Mr. Greene states that in one year three of the leading companies spent $1,500,000 in this direction, an amount equal to five per cent. on their entire capital stock. We might add that but comparatively few of these patents have been sustained and of those which were, many have been put to illegitimate uses. Patents have been used to coerce customers into the purchase of all kinds of apparatus used in conjunction with patented articles, under threat of not furnishing the latter to be used with the accessories of any other manufacturer. Again, patents have been and are to-day carried on the books of some of the large manufacturing concerns at many times their value, if we take the value of a patent at what it would bring if sold in the market under foreclosure of the company. Insolvent concerns have made their finances appear in a satisfactory condition for the time being by arbitrarily adding any required amount to their assets under the item of patents. These uses of patents are neither legitimate nor honest, yet they have been practiced to the great detriment of the business.

Another point of extravagance in the electrical business, which has, however, been unavoidable heretofore, is the displacing of stock on hand by improved devices which made everything previously manufactured practically obsolete and worthless. New stock has often been sent to the scrap heap because of an improvement which rendered it antiquated and useless within a few months. Still another unavoidable expense has been the experimental work and researches for improvement in every direction.

As to the outlook, we venture to think patent litigation on the large scale will undoubtedly soon draw to a close, if not by agreement, then because of the gradual expiration of the fundamental patents. Systems and apparatus are now practically standardized and the rapid changes of the past have ceased to depreciate all the stock carried by a company. There appears to-day no reason why a turning-point in the trade should not be speedily reached, beyond which it will be possible to determine the selling price of apparatus upon its manufacturing cost, and at a decent profit.

THE N. E. L. A's WORK.

ONE of the most prominent speakers at the recent meeting of the Northwestern Electrical Association went to considerable length to demonstrate that the National Electric Light Association was an effete body that had long since outlived its usefulness, and was only maintained to gratify some people's personal vanity or to support a sinecure for some one. We denied these statements at the time and stated our belief that the N. E. L. A. had a mission to fill, and an important one, quite distinct from that of the State or sectional electrical organizations which have been formed. That we were not mistaken in our estimate of the value and vitality of the pioneer organization is shown by the interim report of Mr. Frederic Nicholls, the president of the N. E. L. A. This deals first with the relations between the central stations and the manufacturing companies. Judging from Mr. Nicholls' report, it would seem that the manufacturing companies are quite willing to lend an attentive ear to a word from the association, and that unfair competition can be suppressed when the oppressed party calls the association to its aid. This only proves once more the fact, long since apparent, that the central stations, far from being at the mercy of the "parent companies," now, in fact, dominate the situation; but this domination we are glad to believe will only be called into play to right a wrong or to secure a better quality and higher standard of manufactured product. Another good piece of work accomplished by the association since last May is the issuance of reliable data on the electric lighting of 400 cities in the United States, which will shortly be followed up by a supplementary list of additional cities. Besides this the collecting of information on the laws passed by State Legislatures affecting electrical companies has been taken in hand and promises to become a valuable feature of the association's work. We congratulate Mr. Nicholls on the energy he has displayed since his induction into office, and believe more firmly than ever that when his term of office expires, the association's critics will have no fault to find with its work.

MISCELLANEOUS.

ALTERNATE CURRENT TRANSFORMERS.[1]

BY DR. J. A. FLEMING, F. R. S.

THE ACTION OF THE TRANSFORMER.

In the last ten years the alternate current transformer has been developed from an experimental instrument into a practical appliance of immense utility. According to recent statistics, there are at present about 50 alternating current electric supply stations in the United Kingdom, supplying not less than 1,100,000 8 candle-power lamps. This amount of lighting requires the expenditure of 54,000 horse-power, or 40,800 kilowatts at full load, and hence there must be transformer capacity in the United Kingdom at the very least equal to 40,000 kilowatts. These transformers, as presently to be explained, all contain an iron core, which has to be magnetized and demagnetized 200 times a second, or 6,000,000 times a year. The total weight of iron cores in the whole of these transformers will be certainly not less than 400 tons, and it will require at least 400 kilowatts to maintain the magnetization of these cores. If these transformers are connected with the circuits only, on the average, 4,000 hours a year, it is very easy to see that the magnetization of the cores of the transformer will require not less than 1,600,000 Board of Trade units spent per annum in magnetism, and this means at least 16,000,000 lbs. of coal, or 8,000 tons. Hence, in the United Kingdom, we have buried away somewhere or other at least 400 tons of iron forming the cores of transformers, and these involve at least an expenditure of 8,000 tons of coal, costing some £6,000 sterling to maintain that magnetization. It is, therefore, easily seen that the study of the construction of the alternate

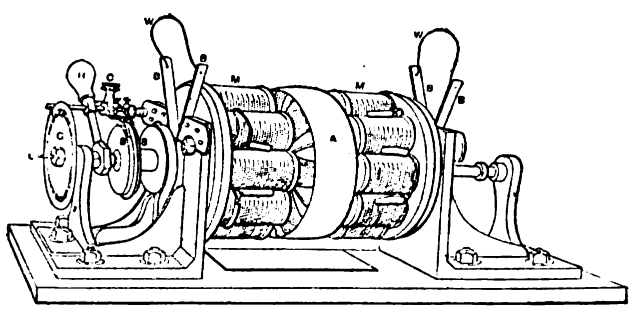


FIG. 1.—ALTERNATING CURVE TRACER.

current transformer, and its possible improvement, is one which is not at all unimportant, from an engineering point of view.

I propose to assume in these lectures that the majority of those present are acquainted with the principal facts connected with the flow of alternating currents of electricity in inductive circuits, and to address myself more particularly to the study of alternating current transformers from a practical point of view, discussing in the four lectures of this course the action of the transformer, the construction of the transformer, the testing of the transformer, and the employment of the transformer. You are all probably aware that an alternating current transformer in its simplest form consists of two circuits of insulated wire which are wound upon an iron core, and that this device operates to transform electric energy in such fashion that the flow of an alternating current through one circuit is made to produce another current in the second circuit, with an increase or decrease of current strength taking place at the expense of potentials. The transformer does no more than any lever, wheel and axle, or simple machine in transforming power from one form into another form. The general operation of the transformer or induction coil, in whatever form it may be taken, is then as follows:—Through one of the circuits, called the primary circuit, is passed an intermittent, interrupted, or alternating current. This primary circuit is interlinked with a magnetic circuit, and the primary circuit establishes in the magnetic circuit an intermittent, interrupted, or alternating induction; the magnetic circuit is interlinked with a secondary circuit, and the variation of magnetic induction in the core creates an electromotive force in the secondary circuit, which at any instant depends upon the rate of change of the total induction linked with the secondary circuit.

As the word "induction" will very frequently be mentioned during the succeeding lectures, it is exceedingly important there should be no ambiguity in your minds as to the meaning of this term. We may help ourselves by regarding the analogy of conducting circuits and magnetic circuits. Consider a conducting circuit in which an electric current exists. As long

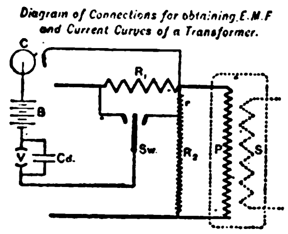


FIG. 2.

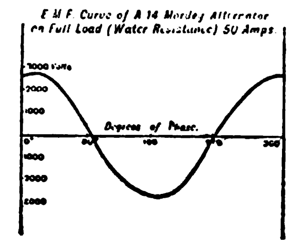


FIG. 3.

as the circuit is closed we recognize the presence of the current, either by heat produced in the conductor, or by electrolysis, and by various magnetic and dynamical actions in the medium round it. We select some one of these effects, say the electrolytic effect, and we base our quantitative definition of current strength upon it; thus, for instance, the accepted definition of an ampere is that it is a current which in one hour deposits, electrolytically, 4.025 grammes of silver. The cause, whatever its nature, producing the current is called the electromotive force. If we draw any line linked with or surrounding the conductor conveying the current, whether that line be included in a magnetic material like iron, or a non-magnetic material like air, we find a physical action taking place in that path which is called magnetic induction, and the immediate cause of this magnetic induction we speak of as magnetic force. We measure this induction by one of the effects it can produce, namely by the electromotive force which it can set up in another conducting circuit linked with the magnetic circuit when that induction is suppressed or reversed at a given rate. Faraday showed that the proper measure of the total magnetic induction linked with any conducting circuit was the total quantity of electricity set flowing in the circuit when the magnetic induction is suppressed or reversed. In practical work it is better to abandon the rather academic phrase, "number of lines of force" or induction, so much used, and to think of the induction as a physical effect produced in the magnetic circuit, its value being reckoned in webers, the induction being produced in the magnetic circuit by magnetic force, just as electric current reckoned in amperes is produced in the conducting circuit by electromotive force. Hence we have this definition of a unit of magnetic induction. A unit of magnetic induction, called one weber, is an amount of induction which, when linked or unlinked with a circuit of one turn, and having a resistance of one ohm, causes one coulomb of electric quantity to flow round the conducting circuit. Generally speaking, if induction is measured in webers (1 weber $= 10^8$ C.G.S. units), we have the following relation between the magnetic induction, the number of turns or linkages which the secondary circuit makes round the line of the induction, the resistance in ohms of the secondary circuit, and the total quantity set flowing in the secondary circuit reckoned in coulombs.

$$\text{Webers} \times \text{linkages} = \text{coulombs} \times \text{ohms}.$$

Since one weber is a larger amount of induction than is met

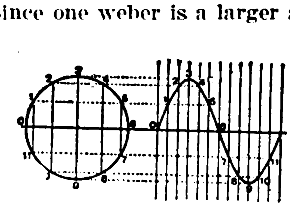


FIG. 4.

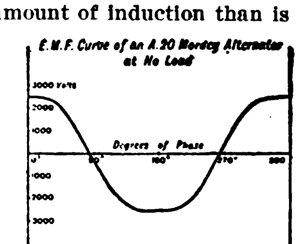


FIG. 5.

in any single transformer core or dynamo magnet, it is convenient to take the millionth part of this as the practical unit, viz., the microweber, and to commit to memory the following rule: Microwebers × linkages = microcoulombs × ohms, and to recollect that one microweber is equal to 100 C.G.S. units of induction, or what would commonly be called 100 lines of force. In order to measure induction, we require then a ballistic galvanometer as a practical instrument to measure electric

[1] Society of Arts Cantor Lectures.

quantity; and we can at once make a measurement of the induction in any magnetic circuit by determining the quantity of electricity set flowing in a circuit of a known number of turns which is linked with this induction, and then unlinked, by withdrawing the circuit or reversing the induction. As a practical illustration of these methods, it will be useful to make a measurement of the induction existing in this closed iron ring, when it is magnetised by a current flowing round it.

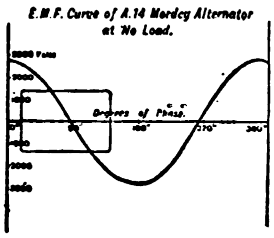


FIG. 6.

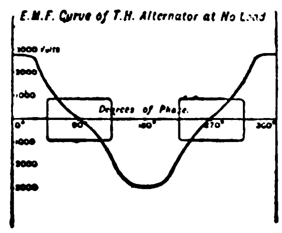


FIG. 7.

The ring, as you see, is wound over closely with one layer of wire, which we will call the primary circuit. If we measure the mean perimeter of the ring, and count the number of turns, it is a simple matter to obtain the number of turns per centimetre. If a current, measured in amperes, is set flowing through this current, then it can easily be shown that the magnetizing force acting upon the iron is equal to 1¼ times the turns of wire per centimetre, multiplied by the ampere current flowing through the circuit[3]. This magnetizing force produces in the iron a certain magnetic induction which is measurable in microwebers. In order to find out the magnitude of this induction, we put upon the ring a secondary circuit of a known number of turns. We then employ a ballistic galvanometer suitable for measuring electric quantity, and we must first calibrate this ballistic galvanometer to determine the excursion or throw of the needle, when a given quantity of electricity measured in microcoulombs is sent through it. This is most easily done by charging a condenser of half a microcoulomb by means of a standard cell having an electromotive force of 1.5 volts, and discharging this quantity of $1.5 \times .5 = \frac{3}{4}$ microcoulomb through the galvanometer. This produces a certain throw or excursion of the needle, and we may then assume that for any other throw of the needle the quantity of electricity producing it is proportional to the throw as determined by the above calibration. In order to measure the magnetic induction in the iron circuit, all that we have to do then is to connect the secondary circuit having a known number of turns, and the resistance of which, added to that of the galvanometer and connecting wires must be determined in ohms, and observe the throw of the galvanometer needle, which is produced when the primary current is reversed. Ascertaining from the previous calibration the electric quantity measured in microcoulombs represented by this throw, we multiply that number by the total resistance of the secondary circuit, including the galvonometer measured in ohms, and divide the product by the number of linkages or turns of the secondary circuit. This quotient gives us double the induction measured in microwebers existing in the iron core at the time when the steady current is flowing through the primary circuit, hence the induction is at once measured in microwebers.

Returning then to the alternate current transformer, we may classify transformers, converters, or induction coils as they are also called, according to their construction, and their use as

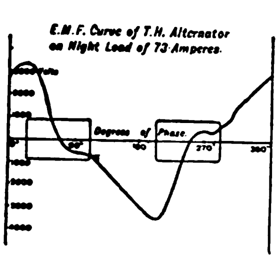


FIG. 8.

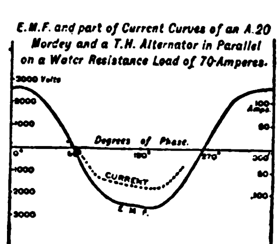


FIG. 9.

follows: Transformers may be (a) iron-core transformers, with a core wholly or partly of iron; (b) air-core transformers with a core or magnetic circuit wholly of non-magnetic substance. Iron core transformers may be (c) closed iron circuit transformers with a magnetic circuit wholly of iron (d) open circuit transformers with a core partly of iron. Transformers may be used (e) to transform a potential difference in a constant ratio, in which case they are called constant ratio transformers; (f) to transform a current strength in a constant ratio, in which case they may be called constant transformers. The transformers may be employed (g) to raise pressure or current, and they are then called "step up" transformers; (h) to lower pressure or current, and then they are called "step down" transformers. This is not an exhaustive classification, but it is sufficient for practical purposes. By far the most important member of the group is the constant potential closed iron circuit transformer employed with alternating currents taken from a constant potential primary circuit. This may be considered from its importance to be the chief of the clan, and to it, therefore, we shall pay most attention. In order to possess a complete knowledge of the operations and action of such a transformer, we require to know the nature of the operations going on in all parts of it at the same instant. We have seen that the broad general action of the transformer as employed with alternating currents is as follows: If an alternating primary current is passed through the primary circuit it acts upon the iron core with an alternating magnetic force, and creates in the iron core an alternating magnetic induction. If a secondary circuit is also wound round the same iron core, the periodic variation of magnetic induction in the magnetic circuit creates a periodic electromotive force in the secondary circuit, and if that circuit is closed, creates in it a periodic secondary current. The method which of late years has proved most fertile in adding to our real knowledge of the subject of the transformer is that of delineating graphically the various periodic quantities concerned, by a process which is called alternating current curve tracing. It is, therefore, necessary to study this process in some detail. Suppose that we have an alternating current dynamo or alternator in operation, we know that the potential difference between the terminals of this machine undergoes periodic variation, and that it passes from one maximum in one direction to another maximum in an opposite direction. At any instant the machine is producing an electromotive force which is called its instantaneous value. Suppose that the alternator terminals are connected to a condenser, the

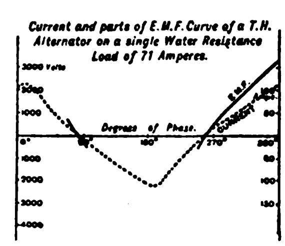


FIG. 10.

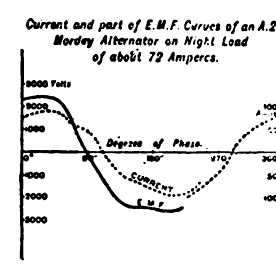


FIG. 11.

potential difference of these condenser plates follows the same law of variation as the electromotive force of the machine. If the condenser is removed at any instant, and the potential difference of its plates examined that will give us the potential difference of the terminals of the alternator, or the electromotive force of the alternator, at the instant when the condenser was disconnected. The practical arrangements made for doing this, which I have found it convenient to use, are as follows: A small alternating current motor (see Fig. 1) has its field magnets excited by a constant continuous current, and its armature traversed by a current coming from the alternator under examination. The shaft of this alternating current motor carries an ebonite disc, on which is placed a small steel slip. As the disc rotates, the steel slip passes at each revolution underneath two small steel springs, lightly touching the ebonite disc. The steel slip, therefore, electrically connects these springs (which are otherwise insulated) together, and this connection takes place at each revolution. The two springs are carried on an insulated bar, which is capable of being moved round an arc of a circle in such a manner that the instant when the springs are connected together can be altered and determined by the angular position of the rocking bar, carrying the two springs as read off on a scale. If this little alternating current motor is started in step with the alternating current machine it will keep in step with it, and will close the circuit of the two springs once during every revolution at an instant during the complete phase of the electromotive force depending on the position of the springs. These two springs, constituting the revolving contact breaker, are connected in series with a small battery of lithanode cells, B (see Fig. 2), and these again with an electrostatic voltmeter, V, across the terminals of which a condenser, C d, is joined This appliance may then be employed to determine the form of the curve of an alternating current, or an electromotive

[3] Vide "The Alternate Current Transformer," Fleming. New Edition. Vol. i., p. 23.

force, as follows:—Suppose it be desired to determine the curve of electromotive force of any alternator, the contact breaker is joined across the terminals of the alternator, and the reading of the voltmeter is taken as the rocking arm carrying the springs is moved round by steps through an angular interval corresponding to one complete period. At equal intervals during the movement, the electrostatic voltmeter is read, and in order to bring the readings within the best part of the scale of the voltmeter, a selected number of the cells of the battery, B, are placed in series with the voltmeter so as to add a known electromotive force to the electromotive force being measured[3]. By the employment of a revolving contact breaker of this form, a number of curves were taken from the alternating current machines in the City of London Electric Lighting Station at Bankside, some of which are shown in the accompanying figures.

Fig. 3 represents the electromotive force curve of a Mordey alternator on full load, the load being a water resistance. It will be seen that the curve of electromotive force is not very far from a simple periodic or simple sine curve, as shown in Fig. 4. Fig. 5 shows the electromotive force curve of a larger Mordey alternator at no load, and Fig. 6 shows the manner in which the electromotive force curve, at no load, is related to the position of the pole-piece represented by the rectangular line. The electromotive force curve of an alternator is, however, not by any means always so nearly a simple periodic curve. Fig. 7 represents the electromotive curve of a Thomson-Houston alternator taken at no load. The position of the field poles with respect to the electromotive curve being shown by the square rectangles in the figure. Fig. 8 shows the electromotive force curve of the same machine when working on a highly-inductive load of transformers. In order to determine the form and relative position of the current curve, all that it is necessary to do is to put in series with the alternator circuit a non-inductive resistance sufficient to carry without sensible heating the outgoing current. By connecting the revolving contact breaker and associated voltmeter with the terminals of this non-inductive resistance, we can delineate the curve of fall of potential down the non-inductive resistance, which is identically the same thing as the curve of current in the resistance.

In this manner have been determined the current curves taken from the above-mentioned machines, both on inductive and non-inductive loads. Fig. 9 shows the electromotive force curve and part of the current curve of a Mordey and Thomson-Houston alternator on a water resistance; and Fig. 10 shows the current curve and part of the electromotive force curve of a Thomson-Houston alternator, working on a water resistance. These diagrams show that when an alternator, having an electromotive force of 2,000 volts, is working on a water resistance, this load is an absolutely non-inductive load, the current curve being practically perfectly in step with the electromotive force.

This leads to the conclusion that in testing a high tension alternator for efficiency, it is quite sufficient to load up the machine on water resistance to measure the current going out of the machine as ordinarily measured on an alternating current ammeter, to measure the difference of potentials at the terminals of the machine, as measured on an alternating current voltmeter, and to multiply the values of the two readings together, and thus obtain the true power in watts being given out by the machine on the water load. There is no question of difference of phase in this case. If, however, the alternator is working upon an inductive load, such as a number of transformers lightly loaded, then the current curve lags behind the electromotive force curve by a definite amount at the

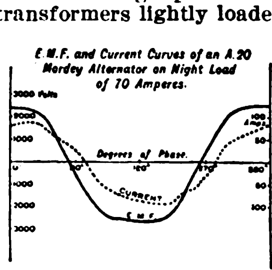


FIG. 12.

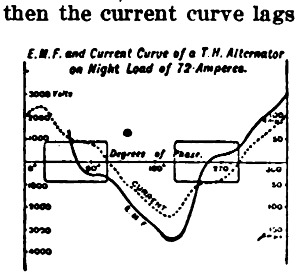


FIG. 13.

zero value. This is shown in curves, Figs. 11, 12 and 13, giving respectively the electromotive force and current curves of a Mordey alternator, and a Thomson-Houston alternator working on transformers lightly loaded. It will be seen that the difference of phase between the current and electromotive force curves is different at different parts of the curve; in the case of the Thomson-Houston alternator there is no difference of phase between the maximum values of the current and electromotive force, but a considerable difference between the zero values. In the diagram of the Thomson-Houston alternator the position of the field poles is shown by the square rectangles, which, therefore, indicate the manner in which the electromotive force curve is related to the field poles in the machine. It must not be supposed that the form of the current curve, or of the electromotive force curve, is a fixed attri-

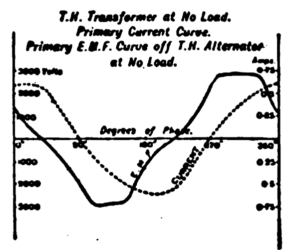


FIG. 14.

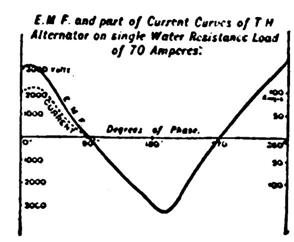


FIG. 15.

bute of the alternator, that is to say, we cannot speak of the electromotive force curve of an alternator as if it were something unchangeable and peculiar to that machine. It often largely depends upon the nature of the load. Thus, for instance, in Fig. 14, is shown the form of the electromotive force curve of a Thomson-Houston alternator when very lightly loaded, and in Fig. 15 is shown the electromotive force curve of the same machine when loaded on a non-inductive resistance to a fair proportion of its full load; whilst on referring to Fig. 13 we see the form of the electromotive force curve of the same machine when working on an inductive load, and it will be noticed how very different in form are those three curves.

[3] For further details see the "Alternate Current Transformer." Fleming, Vol. i. (new edition), p. 521.

THERAPEUTICAL EFFECTS OF CURRENTS OF HIGH FREQUENCY.[1]

BY A. D'ARSONVAL.

CURRENTS of high frequency act powerfully to increase the intensity of organic composition as I have demonstrated previously. I have thought for some time that this particular method of electrical energy would give good effects in the special class of diseases so long studied by my friend Prof. Bouchard, under the name of "Diseases due to Lack of Nutrition." Certain forms of surgary diabetes, gout, rheumatism, obesity, etc., are in this class. I instituted at the beginning of the year a series of clinical researches on this subject. The experiments were made at the Hotel Dieu by the medical staff directed by my assistant, Dr. Charrian, and were under his control from the medical point of view. The results obtained so far have so completely met my expectations that I am able to describe some of them now.

These are the methods instituted in these researches: I reject completely all the results depending upon the imagination of the patient, and take account exclusively of the physico-chemical modifications or exact clinical measurements. I eliminate in this way entirely the subjective changes which would be attributed to suggestion. Besides, positive results were obtained with animals and we can answer such an objection to start with in the case of patients.

The observations recorded by the author refer to two patients with diabetes and one with obesity. The variations of temperature were taken twice a day, as well as the arterial pressure, which was measured by the aid of the sphygmomanometer of Prof. Potain. The analysis of urine was made by Mr. Guillemonat and was carried out in the following manner: Each day from urine passed in twenty-four hours there was taken one-fifth for example of the total volume. Every five days an analysis was made. By this process we have a method which eliminates the causes of error due to daily variations. Precautions were naturally taken to prevent the decomposition of the urine. The urotoxic co-efficient of the urine, a co-efficient of which we know the great importance to-day, thanks to the work of Mr. Bouchard, was taken by Mr. Charrian in his laboratory. Finally, the application of current was made with the greatest caution under my directions by Mr. Bonniot, not connected with the staff, who was a pupil of Drs. Tripier and Apostoli. In a word, every precaution was taken to give these observations a character of precision which should give them value. The analysis of the gas of respiration as well as the radiation of heat from the patients was taken with equal care.

A word now as to the arrangement of the instruments per-

[1] From "L" Industrie Electrique."

mitting the production of currents of high frequency at the bed of the patient. I could not consider using the apparatus described in my previous communication for the reason that the Hotel Dieu is not connected to an electrical station. In order to periodically charge the condenser I had recourse to a Ruhmkorff coil, operated by storage batteries. Under the influence of the energetic current which traverses it the hammer very rapidly soldered itself to the anvil and this closing in short circuit led to the rapid deterioration of the coil and the accumulators, if constant care was not taken to prevent this action. To avoid this, I had made by Mr. Gaiffe the following modification shown in the accompanying illustration, Fig. 1. The anvil, instead of being fixed, was continually rotated by means of a small electric motor operated from a

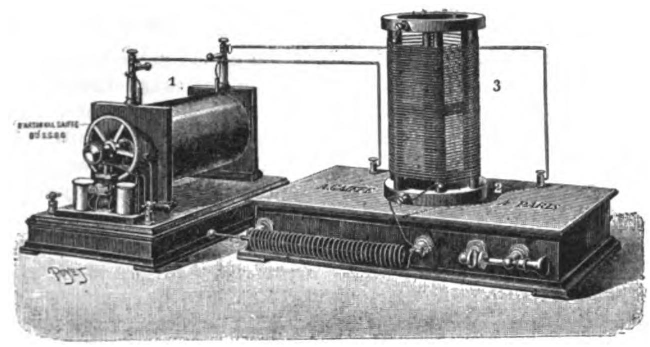


FIG. 1.

branch circuit from the accumulators. If the sticking took place it could not be maintained, and the interrupter thus acted without any watching. The coil charges the flat condensers connected in series, which are contained in the box situated alongside of the coil.

The current of high frequency was taken off as usual at the extremities of the solenoid. Its intensity was regulated by using a greater or less number of coils, and it was measured by the galvanometer, represented in Fig. 2, which is constructed to measure currents of high frequency. This is a thermo-galvanometer, composed of a fine wire, the heating of which is registered by variations in its length, and is indicated by a movable needle upon a scale divided experimentally in milliamperes on one side, and in volts on the other. This apparatus permitted us to pass through the organism currents of which the intensity was upwards of 500 milliamperes.

I have indicated already three principal processes for electrization by currents of high frequency. The first consists in bringing to the part of the body which one wishes to treat the currents which come from a solenoid, by means of con-

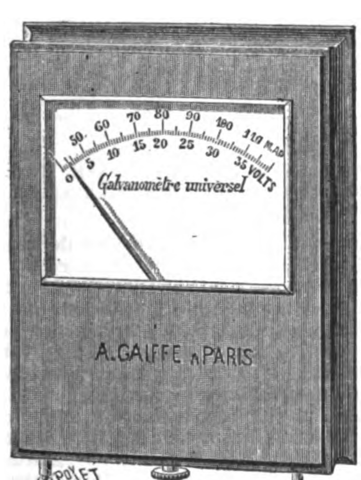


FIG. 2.

ductors with appropriate electrodes. The second consists in placing the patient in a solenoid which does not touch him, but which induces in his body currents of a similar frequency. This is the method of auto-conduction or induced faradization. In the third method the patient constitutes one of the armatures of a condenser charged statically by the solenoid as represented in Fig. 3.

In the observation here analyzed the first process was employed. The currents from the solenoid, traversed the entire body from the hands to the feet. One of the poles of the solenoid was connected with the water in a foot-bath, in which the patient placed both feet. The second pole was connected to both hands by a two-part conductor terminating in metallic handles. Under these conditions the current was distributed, and its intensity was varied between 350 and 450 milliamperes. The duration of treatment made daily was at first of six minutes and was lowered successively to five and to three minutes according to the sensitiveness of the patient. This current, I repeat, acted without the knowledge of the patients, so they submitted without repugnance to the operation.

The following observations are simply our conclusions: High frequency always acts powerfully on the circulation, and suggestion is not sufficient to explain the good effects of electricity, since the patients who had not benefited by the treatment had faith in it, contrary to precedent, and were astonished to find themselves no better. If this view opens new promise to therapeutics I wish to put it before doctors in a clinical point of view. I have shown experimentally that high frequency is a powerful modifier of organism.

I should add a word from the theoretical point of view. Why is it that these currents which act so powerfully make no impression upon the sensibilities? Physicians say that the cause is their superficial localism. I have shown by abundant proofs of a physiological order that these currents on the contrary penetrate deeply into the organism and operate notably on the vaso-motor centers. Physicians have not considered that their explanation only applies to bodies which are good conductors, like the metals. In the case where the conductors considered have only the conductivity of the human body (inferior to that of water in the ratio of 1 to 100), the same rules show that the division of the current should be sensibly uniform through the organism. It is easy to verify this, however, as I have done, with a cylinder of glass full of salt water, of which the dimensions were 70 centimeters in

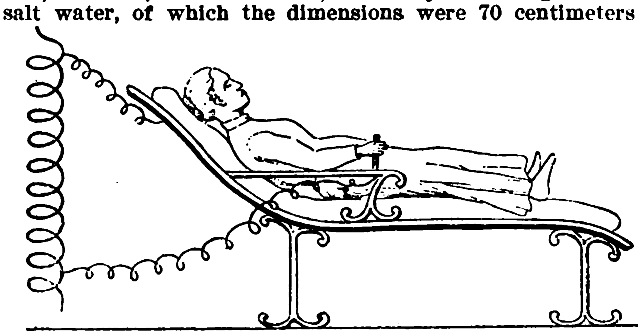


FIG. 3.

length and 25 centimeters in diameter. The density of the current whether at the center or near the outside did not vary at all in its value. The true explanation of the harmlessness of currents of high frequency is, therefore, of a physiological nature, in conformity with what I have stated on the subject.

THE ORGANIC MEMBRANES AS INSULATORS.[1]

BY SIR BENJAMIN WARD RICHARDSON, M. D., F. R. S.,

Up to the present time we have been content to look upon a membrane of the body, the pericardium, the periosteum, the capsule of the kidneys, and any structure of the kind, as a covering of the organ wrapped up in it, that holds the organ, as it were, in a mold, supports it in its place, allows it to glide, and by virtue of the fluid secreted, keeps it distinct and separate. There can be no question that these grand functions belong to the membranes, which have ever been to us structures of the utmost moment. I have watched the influence of many substances upon them; have noted their conditions during the various stages of life, and have examined their degenerations during disease and after death. But I have recently made observations on these structures—membranes—which, if I am right, give them a new value, or rather a value that has not before been appreciated. It seems to me they are electrical insulators, and by their presence confine and render useful the vital force that is developed in the organs they surround. My first observations leading to this conclusion were conducted on the nervous membranes—those that envelop the cerebral convolutions and the spinal cord; from these I passed on to the other membranous envelopes, to find that they all have a common quality.

I obtained an electrical battery consisting of 24 small cells, so arranged that one cell could be put on at a time, or the whole, or part of the whole, as might be required. I commissioned Messrs. Faraday, of Berners street, to construct for

[1] London "Lancet."

me a delicate galvanometer, the needle of which moved in a millimetre circle and certified, with accuracy, the force of the current transmitted. I fixed to one pole of the battery a conductor which was connected to the galvanometer, and from the opposite pole of the battery attached a platinum conductor of the same length and carried it also to the galvanometer. This last conductor I divided in the center and joined the end of the portion from the galvanometer to a platinum disk that was secured by its under surface to a porcelain slab. The other half of the conductor (from the battery) was allowed to remain free with a probe-like end, which could be used at any moment to touch the platinum disk and complete the circuit, or to touch any substance laid upon the disk that would either conduct or break the current. The apparatus, when complete, acted perfectly, and the minutest current could be detected. Sometimes I used the battery with a single cell, sometimes with more than a single cell, while, as a general rule, I used the whole power of cells—24 in number. When all was in order and the battery in action, the platinum probe was brought into direct contact with the platinum disk, and the current was proved by the deflection of the needle on the galvanometer. After this, the needle being steadied and set, a piece of some thin membrane was laid on the platinum disk, and its conduction or resisting power tested with the results to be described.

Dura Mater.—A disk was cut from the dura mater of a dead sheep, and, after being thoroughly cleaned, was laid on the platinum disk. The probe-like end of the conductor from the battery was then pressed upon it, when the current was found to be completely intercepted. The insulation was in fact, perfect. A piece of membrane covering the spinal cord at its upper part, stripped off and carefully cleaned, was laid on the platinum disk, and the probe end of the conductor was put upon it. It resisted the current as effectively as a layer of india-rubber or gutta percha or a fine slice of fatty tissue could have done.

Periosteal membrane.—From off a bone a bit of periosteum detached, cleaned, and laid on the platinum plate insulated perfectly.

Pericardial membrane.—This membrane was tested in the most careful manner and yielded the same result.

Endocardial membrane.—There was more trouble with endocardial membrane than with pericardial, for the structure is very fine and strongly adherent to the underlying substance. But when cleanly dissected out, it was found to be as perfect an insulator as the pericardium, so that the heart structure proper is apparently inclosed in two layers of insulating membrane. The endocardial lining of the arteries showed the same character; the valves of the heart cut out entire did not absolutely insulate, but the membrane covering them on either side did.

Peritoneal membrane. —Portions of peritoneal membrane were taken from various parts—from the liver, from the spleen, from the intestine and from the bladder. When the membrane was derived from any of those sources and scrupulously cleaned and spread out on the platinum disc, it resisted just as the other membrane had done, and proved itself an insulator.

Capsule of the kidney.—The readiness with which the capsule of the kidney can be detached renders it a good specimen for experiment, and it was freely used. It proved to be a perfect insulator, and we may consider that the kidney as it swings in its place is completely insulated.

Lining membrane of an egg.—The thin lining membrane of an egg detached from the inside of the shell, when tested, showed the same insulation.

It was a question whether mucous membrane in the same manner as serous membrane resists the current. To test this fact, mucous membrane was taken from the side of the tongue of a sheep, from the lining of the intestinal canal, and from the lining of the trachea. The membrane had to be carefully cleaned, with the greatest attention to detail, and when it was laid out in its pure character of membrane it also insulated.

In the above, physiological observations have alone been named, but there are pathological ones connected with the subject of equal moment. The absorption of water by membrane, water being a conductor, may interfere with insulation in the case of dropsies, and some deposits may also interfere, but these and other points remain for investigation.

HÜBNER STORAGE BATTERY PLATE.

A novel form of electrode has been invented by George Hübner, of Baden, in which the active material may be cast without any supporting grid, and which has a hard, porcelain-like finish.

In constructing these plates, there are melted together nitrated hydrocarbons, e. g., dinitrobenzol, mononitrobenzol, or bromonitrotluol, with nitrated cellulose, e. g., mononitrocellulose, cellulose meal, and lead oxids. The cellulose meal may be prepared by grinding cellulose. For cheapening the plates it is advisable to add tar or its derivations. The mixture, when cooled, forms a dense, hard, porcelain-like product. Before it cools it can be cast in molds, and be thus formed into plates, which without any support or other accessory are sufficiently rigid to be used as storage-battery plates.

Plates having about one hundred square centimeters area, constructed as described, may be charged with a current of from thirty to forty amperes without suffering in any way.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES—IV.

BY J. A. FLEMING, M. A., D. SC., F. R. S., M. R. I.

Leaving the further elaboration of these points, we must next notice some of the facts with respect to the magnetization of iron at low temperatures. Professor Dewar mentioned in a discourse on the scientific uses of liquid air some results obtained on cooling small steel magnets. These effects we have since again explored at greater length. Let me show you in the first place the effect of cooling a small steel permanent magnet to the temperature of liquid air. We will first take a magnet made of knitting-needle or ordinary carbon steel, and examine the effect of low temperature upon it. Placing the magnets behind the small suspended magnetic needle of a magnometer, we obtain a deflection of the magnetometer needle which is a measure of the magnetization of the magnet causing the deflection. On bringing up a small vessel of liquid air and immersing in it the magnet under test, we notice at once a sudden decrease in the deflection of the magnetometer needle. This indicates that a notable percentage of the magnetization of the magnet has been removed. On taking away the air bath and allowing the magnet to heat

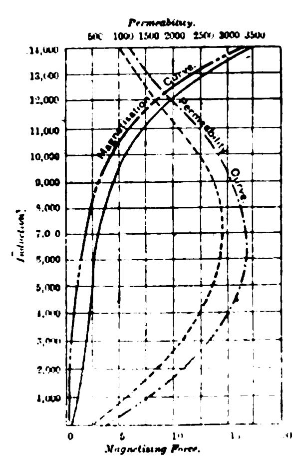


FIG. 10.—PERMEABILITY OF SOFT ANNEALED IRON. TWO OUTER CURVES AT 15° C.; TWO INNER CURVES AT 186° C.

up again we find that there is a still further decrease in magnetization. On cooling it again with liquid air the magnetization increases, and from and after that time the effect of the cooling is always to increase the moment of the magnet, and the effect of heating it up again always to decrease the moment of the magnet. Hence we see that the effect of the first immersion in liquid air was to give a shock to the magnet which deprives it permanently of a considerable percentage of its magnetism, but when once it has survived this treatment, then cooling it strengthens the magnet and warming it weakens it. This is not by any means always the case. If we take a magnet made of the 19 per cent. nickel steel, the peculiar characters of which were explained a few moments ago, we shall find a very different state of affairs. Here we see the first effect is, as before, to remove a very considerable percentage of the initial magnetization, but after that stage is passed, then cooling this nickel-steel magnet always weakens it still more and warming it up again strengthens it. The subsequent effect of cooling is therefore in the opposite direction in the carbon steel and in this nickel steel.

We have in this way examined the behavior of magnets made of a very large number of steels—chromium steels, aluminum steels, tungsten steels, silica steels, and nickel steels in various states of temper hard and soft. We find that in some cases there is no initial decrease of magnetism at all, and that

the steady state begins at once. Broadly, however, the results amount to this: a steel magnet when plunged into liquid air generally loses some fraction of its magnetization, but that after a few such immersions it arrives at a fixed condition, in which the effect of cooling it is in most cases to produce an increase of magnetic moment, but in a few exceptional cases to produce a decrease of magnetic moment.

In the technical use of magnets for instrumental purposes they have to go through a process called ageing to get rid of the sub-permanent magnetism. One of the best ways of ageing a magnet is to plunge it several times into liquid air. We have given a large amount of attention to a study of the changes taking place in the magnetic qualities of soft or annealed and also hard iron when cooled to very low temperatures. In the first place, we have examined the change in the permeability of iron at the temperature of liquid air. If a ring of iron is wound over with a coil of wire and subjected to gradually increasing magnetizing forces, this produces magnetization in the iron, but the magnetization does not increase proportionately with the force. It tends to a limit, and the curve which shows this variation is called a magnetization curve. The number which expresses the ratio of the magnetization to the magnetizing force is called the susceptibility of the iron. Instead

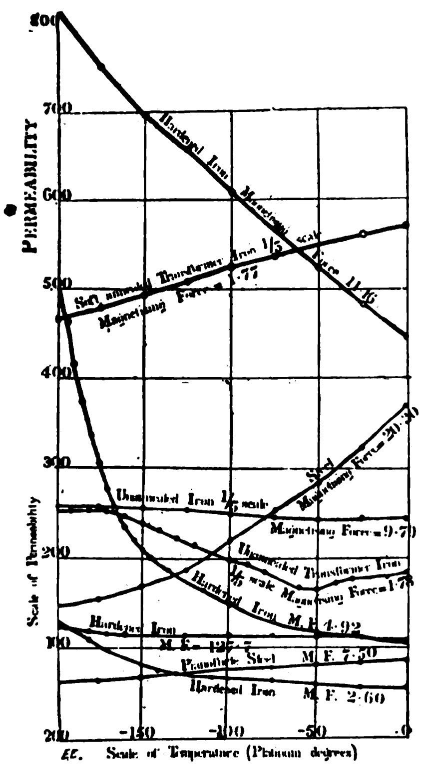


FIG. 11.

of considering the magnetization of the iron as one of the variables, it is often convenient to consider the induction in the iron, and the induction is defined as a quantity the rate of change of which with time measures the e. m. f. set up in a secondary circuit wound round the iron ring.

The ratio between the induction and the magnetizing force at any instant is called the permeability of the iron. By tedious experiments with the ballistic galvanometer, it is possible to draw out a complete magnetization curve of the iron, starting from the lowest induction up to the point at which the iron becomes practically saturated. Assisted by Mr. J. E. Petavel, who has given us most valuable help in these very tedious magnetic observations, as well as the subsequent reductions of them, we have made a large number of observations on the permeability of a carefully annealed iron ring made of very fine Swedish iron of the highest quality (Fig. 10). The result is to show, as seen from the curve (Fig. 11), that cooling the iron to —200 deg. slightly diminishes the permeability. In other words, it requires a greater magnetic force to produce a given amount of magnetization when the iron is at —200 deg. than when it is at the ordinary temperature. When, however, we began to study the behavior of hardened iron in this respect, we found ourselves in the presence of very curious effects. If pure iron which has been carefully annealed is twisted, knocked, bent, stretched or compressed, it passes into a state known as hard iron; and hard iron has very different magnetic qualities from soft iron. A very extended series of experiments with rings of hard iron have shown that hard iron, at least in certain cases, has its permeability greatly increased by cooling; and this change takes place with great suddenness. We can show you by a simple experiment that this is the case. If we take this hard iron ring, which has two coils of wire wound round it, and connect one of these circuits to a battery, we shall send a current through this primary coil and magnetize the iron ring. If the other or secondary circuit is connected to a galvonometer then at the instant of starting the primary current there is a transitory induced current produced in this secondary circuit. As long as the induction in the rion remains constant, no electric change will take place in this secondary circuit. If, however, we plunge the iron ring into liquid air, we find again a secondary current produced at the moment of cooling the iron. This indicates a sudden increase of permeability at the instant of cooling. If we bring the ring out of the liquid air we find it retains some of the increased permeability acquired on cooling, but loses a portion of it more slowly if it is heated up again to ordinary temperatures by plunging it into a bottle of alcohol. Owing to these changes we found it impossible to repeat again exactly any required magnetization curve in the case of the hard iron. The sudden cooling alters the magnetic qualities of the iron to such an extent that it is not possible to get it twice in exactly the same state.

ELECTROMAGNETIC WAVE DETECTOR.

In a recent communication to the Royal Society, entitled "A Magnetic Detector of Electrical Waves and some of its Applications," Mr. Rutherford investigates the effect of Leyden jar discharges on the magnetization of steel needles, and shows that the demagnetization of strongly magnetized steel needles offers a simple and convenient means for detecting and comparing currents of great rapidity of alternation. The partial demagnetization of fine steel wires, over which is wound a small solenoid, was found to be a very sensitive means of detecting electrical waves at long distances from the vibrator. Quite a marked effect was found at a distance of over half a mile from the vibrator. Detectors made of very fine steel wire may be used to investigate waves along wires and free vibrating circuits of short wave-length. Fine wire detectors are of the same order of sensitiveness as the bolometer for showing electrical oscillations in a conductor. This detector also has the property of distinguishing between the first and second half oscillations of a discharge, and may be used for determining the damping of electrical vibrations and the resistances of the discharge circuit.

WIND POWER.

A paper by Mr. E. O. Baldwin, published in the "Canadian Electrician," deals with the author's attempts to utilize the power of the wind for producing current. They are strong at windmills in Holland, where they use them for pumping purposes, but the difficulties in the way of getting a useful supply of current are much greater than when the only work required is to lift water a short distance and speed regulation is of no importance. Mr. Baldwin's regulating apparatus consists of an additional coil on the field magnets to act as demagnetizing coil, and an electro-magnet which attracts a pivoted iron arm against the resistance of a spring and throws the demagnetizing coil into the field circuit whenever the voltage rises above the desired point. There is a very rapid vibration of the arm, and Mr. Baldwin states that he can adjust the regulation so that lamps can be run directly off a dynamo belted to the windmill without any perceptible flickering. Normally, however, a storage battery is used.

ELECTRIC CURRENT IN THE AUDITORY NERVES.

In a communication to the Académie des Sciences, MM. H. Beauregard and E. Dupuy described some experiments carried out by them "On the Electrical Variation caused in the Acoustic Nerve by Sound." These investigators find that whenever a sound falls upon the tympanum, an electric current traverses the acoustic nerve and is proportional to the pitch of the note, though they have not as yet established the connection between the current and the volume of the sound. They point out that this discovery places in the hands of physiological investigators what they consider to be a very certain method of determining the limits of audibility in different animals.

WE have received a circular from Messrs. Moura, Deans & Co., 5 Rua do Hospicio, Rio de Janeiro, Brazil, offering their services as patent solicitors and as a general bureau of information for industry, trade and commerce of Brazil. Mr. A. Guimaraes, of 95 Broad street, New York, is the firm's correspondent in this country.

OLD HORSE CARS AS SUMMER HOUSES.

When the car horses throughout Connecticut cities were retired, a few years ago, with the coming of the trolley, people wondered what would become of the 600 cars that they had dragged so long. No one would have guessed then that a brisk demand for these old cars would spring up in one season and would almost completely exhaust the supply. Yet such has been the case this summer.

The cars have been sold for summer shelters in rural districts, for hunters' camps, for lodges by solitary lakes, for cabins on house boats, and, most of all, for the homes of campers on the coast of Long Island Sound and its islands. As a bicycle advertisement catch line reads, "You see them everywhere" this summer.

All along the Sound beaches from Larchmont to Watch Hill and even out on Block Island these cars are found, poised on breezy bluffs, by purling brooks, and on shining sands, some as annexes to pretentious cottages, some strung together like a vestibuled train, some painted in the most fantastic hues, but all doing duty as efficiently as before the day when the car horse became extinct. The happy idea of using the cars for summer camps has been so generally adopted that one finds a South Norwalk car unexpectedly confronting him at Black Rock Harbor, a lot of Waterbury and Bridgeport cars at Stratford and Merwin's Points, New Haven cars at Woodmont, Savin Rock, and Morris Cove, Hartford and Middletown cars at Branford Point, Double Beach, Guilford, and Saybrook, and Norwich cars and stages on the Thames River and on the Eastern islands. So extensive has the demand become for cars that Station Agent Hayward, at the Union station of the Consolidated road in New Haven, recently received a letter of inquiry from a woman inland, asking him for his lowest prices for passenger cars; also, for a list of styles.

A Norwich party at Scotchcap, on the Thames River, have arranged four horse cars in the form of a hollow square. A canvas awning covers the courtyard made by the cars, and a tall flagstaff rising from the center completes the pleasing establishment. One of the cars is used as a kitchen and workshop, and the others are lounging, sleeping, and reception rooms. Duncan De Wire, on Block Island, has five of the cars, arranged like the connected cars of a vestibuled train.

HORSELESS CARRIAGES.

From recent careful observation of the behavior of petroleum driven carriages, says the London "Electrical Review," it is surprising that many of the French people can run their vehicles at all. They appear to think that the engine needs no attention. Many carriages which in their hands have given difficulty, have been run by a well-known English expert without any trouble. One matter, however, seems to be proved as a consequence, viz., that unless the coachmen of the future are mechanicians, all motor carriages will have to be greatly simplified. Indeed, in certain quarters, much attention is now being given to this part of the subject, and in due course we hope to see a carriage of adequate horse-power and simple in the extreme. In the meantime the public should be warned against buying a good deal of rubbish which is being offered, and we therefore suggest that any would-be purchaser should insist upon the following test before he closes a bargain: He should see the vehicle travel up and down hill for not less than thirty miles at a stretch, and at the end of this trial run it should be seen that none of the parts have become too hot. The question of whether the mechanism is of the most approved type he must naturally leave to an independent expert. There are several carriages in this country about which much fuss is being made, but which we are confident could not perform the journey mentioned, although for short runs such as can be observed at the Imperial Institute, Crystal Palace, the Hurlingham Club, etc., success seems assured. There are many easily-led people who would eagerly purchase a horseless carriage on the strength of such seemingly perfect, though utterly useless, performances.

THE BIG COTTONWOOD POWER CO.

The long distance transmission plant of the Big Cottonwood Power Company, which our readers will remember was described in our pages some time ago, was started on the second of last June. They have since closed a contract with Salt Lake City to furnish three hundred 2,000 candle-power arc lights for street lighting, at $8.50 each per month. The contract is for one year and is based on the Philadelphia schedule.

They have also a ten-year contract with the Salt Lake and Ogden Gas and Electric Light Company to supply current, the minimum guarantee being 2,000,000 units annually.

HORSE POWER AND CRITICISM.

There is a critic who always has his jaundiced eye on our columns, whether to carp at ourselves or our correspondents. In his haste to get at our correspondent, Mr. Steavenson, however, he allowed his physiological ignorance to blind him somewhat. Mr. Steavenson referred to the power exerted by a horse at the moment of starting, and our critic animadverts upon this on the ground that a horse pulling against a resistance and not moving forward can be doing no work, there being no motion. This may be true of a steam-pressed piston, but it is not true of animal power. The horse must expend energy in keeping a stress upon its traces, and to attempt to draw strict mechanical parallels without brains is an erroneous proceeding, though possibly well suited to our critic's capacity. Let him try lifting himself in a basket. He may then perceive that, though he will be performing no useful work—a condition of things to which, no doubt, he is accustomed—he will, in keeping up a steady upward pull, be expending energy that would in time tire the strongest and longest arm.—London "Electrical Review."

ODD JOBS FOR NIAGARA.

The owners of the new Lewiston & Youngstown electric railway, which is to be known by the shorter title of the "Old Fort Route," expect to have the road in operation this week as far as the village of Youngstown at least. Cars have been run within the limits of the village of Lewiston. Power for this road will be supplied by the Niagara Falls Hydraulic Power and Manufacturing Company, it practically being a continuation of the Gorge road service.

Along the route of the Niagara Falls and Lewiston Railway the current of the lower Niagara is very rapid, and efforts to utilize it are likely to be made in the near future. This railway company controls the river bank for a distance of six miles, and could a good current motor be obtained there is no doubt but what it would profit largely by the possible development. Two men have already been ambitious enough to exhibit motors, but both plants were swept away by high water.

The Cataract Power Company, a Canadian concern, not identified with the Niagara development, has offered to run the beach pumping station of Hamilton, Ont., at a price which has led E. A. C. Pew, representing the Hamilton and Lake Erie Power Company, to write stating that he some time ago made a proposition to run the works for $25 per horse-power a year, at which rate he estimates the city would be saved $20,000 a year. Mr. Pew further calls the attention of Hamilton people to the fact that he has enlisted capital in the erection of a plant, and that it was on the strength of a resolution passed by the council that capital was led to invest in the projected electric plant, but the resolution in question was only a promise to consider the scheme.

LYONS, N. Y.—The Wayne County Traction Company has been organized with a capital stock of $60,000, divided into 600 shares of $100 each. The principal office is to be in Lyons, N. Y., the purpose of the company being to construct and maintain a trolley line between Lyons and Newark, N. J., as soon as a charter can be secured. The officers of this company are: President, A. C. Robertson, Athens, Pa.; vice-president, Orlando F. Thomas, Lyons; secretary, D. N. Johnson, Athens, Pa.; treasurer, F. K. Harris, Athens, Pa. Directors: F. N. Dean, Ithaca, N. Y.; Burton Hammond, Charles Taft Ennis, Clement R. Sherwood, all of Lyons, N. Y., and N. C. Harris, Athens, Pa.

THE HAZELTON BOILER COMPANY, New York City, report recent sales of boilers aggregating 2,450 horse-power, among which we notice the following. The Rochester Gas and Electric Company, Rochester, N. Y., 500 horse-power; the Bristol Electric Light and Railway Company, Bristol, Conn., 200 horse-power; the Canandaigua Electric Light and Railroad Company, Canandaigua, N. Y., 250 horse-power. The Hazelton Company report that nearly all of their orders now being received are for the earliest possible delivery, and that many of their recent sales have been made to old customers, who are now enlarging their plants. The original boilers sold to these customers have been in constant operation for from eight to ten years, without repairs, still carrying high pressure, and giving the same good results as when new. This, together with the fact that the Hazelton Company has made various improvements in the construction and setting of their boilers, increasing their efficiency and economy, and improving their appearance, makes it much easier for them to make sales now than formerly. These facts are not only gratifying to the company, but also seem a pretty sure indication of an improved feeling and condition in manufacturing business generally throughout the country.

Society and Club Notes.

ELECTRICAL CREDIT ASSOCIATION FOR CHICAGO.

A meeting of the representatives of the electrical trade of Chicago was held on July 30, to consider the advisability of organizing a credit association, somewhat similar to those existing in Boston, New York and Philadelphia. The following firms were represented:

Washburn & Moen Manufacturing Company, J. A. Roebling & Sons Company, Central Electric Company, Electric Appliance Company, American Electrical Works, Anchor Electric Company, Bryant Electric Company, S. F. B. Morse, American Circular Loom Company, Standard Underground Cable Company, Geo. Cutter, Chicago Edison Company, Western Electric Company, Osburn Bros., Dearborn Electric Company, Chicago General Fixture Company, Chas. E. Gregory Company, Sunbeam Incandescent Lamp Company, Lescoen, Macomber Whyte Company, J. M. Hill, Wagner Electric Manufacturing Company, Columbia Lamp Company, New York Insulated Wire Company.

A temporary oganization was effected by the election of Mr. F. Overbaugh chairman, and Mr. Jas. Wolff secretary. The discussion of a permanent organization was carried on at considerable length, and many valuable suggestions were made. The following committee was appointed to draw up by-laws, etc., for a permanent organization: Mr. W. H. Carpenter, of the Western Electric Company; Mr. C. A. Brown, Central Electric Company; Mr. W. N. Anthony, Chicago Edison Company.

The officers of the temporary organizations will act as ex-officio members of said committee, and a meeting will be held August 11, when it is expected a permanent organization will be established.

The organization of an association of this kind in the West for the protection of the supply houses is one that is greatly needed when the nature of some of the recent failures is taken into consideration, and its permanent establishment should be welcomed by all who believe in transacting business on a sound basis.

EXCURSION OF THE GENEVA INTERNATIONAL CONGRESS OF ELECTRICIANS.

In connection with the Electrical Congress held in Geneva this month, an excursion has been projected through Switzerland, during which the principal electrical installations in that country will be visited. The excursion will last six days, beginning Monday morning, August 10, and ending Saturday evening, August 15. The following itinerary has been prepared:

Monday: Leave Geneva at 7 a. m. Stop at Lousanne to visit the electric railway installation. Stop at Fribourg to visit the electrical and hydraulic plants of the Administration of the Waters and Forests, and the Jurasimplon railroad, the cars of which are lighted by storage batteries. Arrive in the evening at Neuchâtel, passing by Morat and the lake of Neuchâtel.

Tuesday: Excursion to Noiraigue to visit the electric and hydraulic installations at Val-de-Travers. Visit to the elevator works of the Chaux-de-Fonds at Champ-du-Mulin. Visit to the works of Combe-Garrot, supplying Chaux-de-Fonds and Locle. Visit to the works of the city of Neuchâtel, having monophase and polyphase currents. Leave for Berne.

Wednesday: Visit to the municipal plant of Berne. Leave for Langenthal. Visit to the works of Wynau, using triphase current. Arrive at Aarau.

Thursday: Visit to the electric plant at Aarau, using diphase and continuous currents. Leave for Bremgarten. Visit to the works of Zufikon, which supplies triphase current to the manufacturers of Zurich. Arrive at Lucerne. Visit to the electric works at Thorenberg.

Friday: Voyage on the lake of the Quatre Cantons, in chartered boat. Excursion to Stanserhorn—altitude 1,900 meters—by a cable road run by electricity. Visit to the works of Rathausen. Arrive at Zurich.

Saturday: Visit to the electrical plants of Zurich and neighborhood: Oerlikon, Baden, etc.

MEETING OF THE SOCIETY OF THE MILITARY TELEGRAPH CORPS AND THE U. S. OLD TIME TELEGRAPHERS.

The Society of the United States Military Telegraph Corps and the Old-Time Telegraphers' association, will meet in Pittsburgh September 9, 10 and 11 next.

Among the members expected at the meeting are Thomas A. Edison, Gen. T. T. Eckert, president of the Western Union Telegraph Company; A. B. Chandler, president of the Postal Telegraph and Cable Company; J. D. Reid, Andrew Carnegie, Thomas M. King, H. W. Oliver, David McCargo and Robert Pitcairn.

The chairman of local committees are as follows: Arrangements, C. M. Schaefer; transportation, W. D. Vincent; reception, John A. Munson; entertainment, Samuel T. Paisley; press, W. C. Connelly, Jr. Mrs. S. A. Duncan, chairman of the ladies' committee, will look after the reception and entertainment of the ladies.

The Old-Time Telegraphers' association will hold a business meeting Wednesday, September 9 at 10 a. m. at the Monongahela House; at 2 p. m. the business meeting of the United States Military Telegraph Corps will be held at the same place. At 8 p. m. there will be a lecture by A. B. Chandler, Esq., president of the Postal Telegraph Cable Company. Thursday, September 10, an excursion to prominent industrial establishments will be followed by a banquet at the Monongahela House. Friday, September 11, the members will visit the glass works, parks and other points of interest around Pittsburgh.

Educational.

CURRY UNIVERSITY ACQUIRES THE KEYSTONE ELECTRICAL COLLEGE.

The Keystone Electrical College, Pittsburg, has combined with the Curry University electrical department. Dr. Leon Le Pointois, who will be its head, is the electrical engineer of the Baltimore and Ohio Railroad. Associated with him in the new electrical faculty are Charles Hyde, M. E., Victor Bentner, M. E., Prof. J. A. Calderhead, C. E., and Morris W. Mead as lecturer on applied electricity. The course of the institution is to be strictly technical.

Obituary.

SIR WILLIAM GROVE.

The death is announced of Sir William Grove, at the age of 85. He was educated at Oxford, where he proceeded to the degree of M. A. in 1833. Two years later he was called to the bar at Lincoln's Inn. Being temporarily prevented by ill-health from following the legal profession, he turned his attention to the study of electricity, and in 1839 invented the powerful voltaic cell which bears his name.

He was Professor of Experimental Philosophy at the London Institution from 1840 to 1847, and he took an active part, as a member of the Council, in the business of the Royal Society, particularly in the reform of its constitution, effected, after a severe struggle, in 1847. Mr. Grove became a Q. C. in 1853. He first promulgated the doctrine of the correlation of physical forces in a lecture in 1842.

Personal.

PROFESSOR J. P. BARRETT has retired from the presidency of "The Electrical Journal" and from the field of electrical journalism.

THOS. F. CLOHESEY, Electrical Engineer, has completed plans and specifications for an underground cable system for the Fire Department wires at Cincinnati.

MR. ALBERT F. MADDEN, who has been so long associated with the invention and manufacture of storage batteries, has joined the forces of the Electric Storage Battery Company.

MR. JAMES E. KEELYN, president of the Western Telephone Construction Company, of Chicago, will be at the Astor House, New York, arranging important business extensions during the last two weeks in August.

MR. M. N. FORNEY, mechanical engineer, has opened an office in the Taylor Building, 41 Cortlandt street, as a designing, constructing and testing expert, and as a consultative and representative purchasing agent. Mr. Forney's high standing and distinguished ability are known to everyone in the railway and mechanical world, and we do not hesitate to commend his professional services warmly. Mr. Frank J. French will be his business manager.

NIAGARA FALLS.—The Niagara Falls and Lewiston Railroad Company, the "Gorge Road," have purchased a plot of ground 232 feet square between the New York Central tracks and the edge of the bank and are clearing it preparatory to erecting a fine brick and iron car shed, 200 feet square. The building will be 20 feet in the clear, and will stand close to the point where the tracks of the road reach the top of the river bank.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Central Stations:

FRANKFURT ON THE MAIN ELECTRICITY WORKS.—Abstract of annual report.—"Elektrot. Anzeiger," July 23, '96.

COMBINED LIGHT AND POWER PLANT.—The lighting and power supply for Rome is illustrated and described. Tivoli, 12 miles from the city, furnishes the water power. An auxiliary plant is at Rome, the latter being a steam plant. Several interesting illustrations accompany the description part, as, for example, diagram, showing energy transmitted and absorbed in the combined power and light station, load diagrams. Diagram of transformer stations, section of tramway, etc.—Lond. "Engineering," July 24, '96.

Dynamos and Motors:

COMPOUND DYNAMOS IN PARALLEL.—By A. O. Dubsky and P. Girault. A short discussion of the requirements, especially with reference to railroad service.—"L'Ind. Elec.," July 25, '96.

Thermo-Electricity:

THERMO-TROPIC BATTERY AND A NEW METHOD OF DEVELOPING ELECTRICAL ENERGY.—By C. J. Reed. Writer considers that Dr. Jacques' battery is not a galvanic, but a thermo-electric, cell. He furnishes experimental proof and gives also a definition of the difference between galvanic and electrolytic action.—"Elec. Eng'r.," Aug. 5, '96.

Electro-Chemistry:

COMMERCIAL OZONE.—By E. Andreoli. On the various methods of producing azone for practical purposes.—"L'Electricien," July 25, '96.

ELECTRIFIED VAPORS.—By G. Schwalbe. This paper deals with the behavior of the electrified vapors rising from fluids.—"Ann. der Phys. u. Chem.," July, '96.

Electro-Physics:

THE ELECTRO MAGNETIC THEORY OF DISPERSION.—By H. von Helmholtz. Translated with notes from Wiedemann's Ann. by James L. Howard, D. Sc., in Lond. "Elec.," July 24, '96.

ATMOSPHERIC ELECTRICITY.—By C. Chree, D. Sc. Paper read before the Roy. Soc. Some observations made at the Kew Observatory.—Lond. "Elec.," July 24, '96.

POLARIZED FLUORESCENCE.—By L. Sohucke. A contribution to the Kinetic theory of solids. This paper does not deal directly with electricity, but is mentioned here on account of the imporatnce of the subject in connection with Röntgen rays.—"Ann. der Phys. u. Chem.," July, '96.

ON THE DAMPING OF ROTATING DIELECTRICS IN A MAGNETIC FIELD.—By William Duane.—"Ann. der Phys. u. Chem.," July, '96.

ORGANIC MEMBRANES AS INSULATORS.—By Sir Benjamin Ward Richardson, M. D., F. R. S., in the London "Lancet." Quite a number of the membranes of the different parts of the body show considerable electrical resistance.—"Elec. Rev.," July 29, '96.

Lighting:

THE KINCAID ARC LAMP REFLECTOR.—A reflector consisting of four semi-parabolas arranged so as to throw light in four distinct directions at street corners.—"Elec. Eng'r.," August 5, '96.

SERIES GROUPING OF INCANDESCENT LAMPS.—Description of several high voltage systems.—"L'Ind. Elec.," July 25, '96.

Magnetism:

EXPERIMENTS OF MAGNETICALLY SOFT AND HARD BOTTLES.—By Alfons Kohn. An exhaustive study with experimental researches.—"Ann. der Phys. u. Chemie." July, '96.

Measurements:

TRUE RESISTANCE.—By Rollo Appleyard. Author holds that "true resistance" has no proven right in equations concerning the arc, since the word resistance is a conception derived from our experience of homogeneous metallic conductors.—Lond. "Elec." July 24, '96.

INDUCTANCE IN CABLES.—By A. Davidson. A few experiments illustrating the value of inductance as a negative capacity in submarine cables.—Lon. "Elec. Rev." July 24, '96.

A NEW FORM OF QUADRANT ELECTROMETER.—By F. Dolezalek and W. Nerust. Charging one electrometer needle from an outside source is overcome by introducing a small pile on a suspension inside of the instrument.—"Zeitschr. f. Elektrochemie." July 5, '96.

RESISTANCE MEASUREMENT OF ELECTROLYTES.—By F. Kohlrausch. In response to an attack author shows that measurements of electrolytes by means of an alternating current and a dynamometer can be made with a very high degree of accuracy.—"Ann. der Phys. und Chemie." July, '96.

UNIT SPOOLS OF SELF-INDUCTION.—By Max Wien. Author has constructed some standard spools which are practically independent of temperature and time.—"Ann. der Phys. u. Chem." July, '96.

Railways:

THIRD RAIL CONDUCTORS.—By Leo Daft. Some experiences with third rail experiments in the early days of the development of the electric railway.—"Elec. Eng'r." Aug. 5, '96.

RETURN CIRCUITS OF ELECTRIC RAILWAYS.—By Chas. Hewitt. From the "Journ. of the Franklin Inst." A general discussion of the subject.—"Indust. and Iron." July 24, '96.

Telephony, Telegraphy, etc:

TELEPHONES IN RUSSIA.—The aggregate of subscribers for the empire was, in 1895, 9,007 on companies, and 6,111 on Government systems.—Note in Lond. "Elec. Eng'r." July 24, '96.

BURGLAR ALARM.—A jewelry house in Chicago has attached a large bell on the outside of the building, which can be set ringing from many different places in the store.—"Western Elec." Aug. 1, '96.

TELEGRAPH MONOPOLY.—By Prof. Frank Parsons. One of a series of articles in which the telegraph monopoly in this country is being discussed.—"The Arena," July '96, see previous and subsequent issues.

Power Transmission:

NIAGARA-BUFFALO TRANSMISSION LINE.—An illustrated description of the new three-phase pole line and insulators.—"Elec. Eng'r." Aug. 5, '96. "Elec. Rev.," Aug. 5, '96.

COMBINED ELECTRIC LIGHTING AND TRACTION PLANTS.—By Hesketh and Rider. See Synopsis July 29, '96; also for paper in full "Elec. Rev." July 29, '96. Lond. "Elec." July 24, '96.

UTILIZATION OF THE ENERGY OF THE RHONE.—By E. Boistel. Description of the power transmission plant, with sections of the canal and the position of the generating plant.—"L'Electricien." July 25, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 4, 1896.

Alarms and Signals:—

ELECTRICAL FIRE-ALARM SYSTEM. Charles D. Tisdale, Boston, Mass., 565,053. Filed Aug. 27, 1895.

Consists of a core wire of metal fusible at a low temperature, and an insulating material covering said wire, a second wire wound around said insulating material and an outer covering of insulating material surrounding the whole, said insulating coverings being readily destroyed by heat.

FIRE-ALARM SIGNAL BOX. George F. Milliken, Boston, Mass., 565,086. Filed April 20, 1891.

Non-interfering signal box.

TRAIN DESPATCHER'S CHART BOARD. John T. Williams, Brooklyn, N. Y., 565,150. Filed April 30, 1896.

A chart board having arranged thereon a miniature duplicate of the tracks controlled and miniature trains moving upon the chart in accordance with movement of trains on the regular track.

AUTOMATIC ELECTRIC FIRE-ALARM. Charles D. Tisdale, Boston, Mass., 565,188. Filed July 11, 1895.

Consists of two wires, one of which is made of fusible material that will fuse at a desired degree of heat, running side by side around the rooms, but not in contact with each other; an open electric circuit and a sounding device.

COMBINED TELEPHONE AND DISTRICT ALARM SYSTEM. F. Drake, San Francisco, Cal., 565,202. Filed Sept. 26, 1894.

Details of construction.

ELECTRICAL FIRE-ALARM SYSTEM. J. D. Gould, Brooklyn, N. Y., 565,410. Filed Aug. 27, 1895.

Similar to above.

Secondary Batteries:—

ELECTRODE FOR SECONDARY BATTERIES. George Hubner, Gernsbach, Germany, 565,140. Filed June 24, 1895.

For description see page 160.

Conductors, Conduits and Insulators:—

SUBWAY FOR ELECTRICAL CONDUCTORS. William H. Hart, Brooklyn, N. Y., 564,994. Filed May 20, 1896.

Constructed of two series of sections arranged end to end.

ELECTRIC CABLE FOR FIRE-ALARM SYSTEMS. Henry A. Reed, Newark, N. J., 565,178. Filed Dec. 30, 1895.

Comprises a central wire of fusible metal, an electric wire wound around said fusible wire, an insulating material over the two wires, an electric wire wound upon the insulating material, and an insulating material covering the whole.

CABLE FOR ELECTRIC FIRE-ALARMS. Henry A. Reed, Newark, N. J., 565,217. Filed April 20, 1896.

Similar to above.

CONNECTING DEVICE FOR ELECTRIC CONDUCTORS. Howard Gilmore, Easton, Mass., 565,344. Filed March 7, 1896.

The combination of body portion, base, hook, and spring carried by the base, rosette and blade carried by rosette to make the shank of the hook a step for the blade.

Dynamos and Motors:—

COMPOUND-WOUND POLYPHASE GENERATOR. B. G. Lamme, Pittsburg, Pa., 565,284. Filed June 4, 1895.

Consists in producing by induction an independent secondary current corresponding to each phase of primary armature current combining and rectifying such secondary currents and exciting the field magnet coils therewith.

Lamps and Appurtenances:—

ELECTROLIER. N. L. Root, C. L. Reed and D. C. Hale, 565,092. Filed March 13, 1895.

The combination with telescoping stationary and movable members of a helical spring connecting said members to form an extensible electrical conductor.

GLOBE FOR ELECTRIC ARC LIGHTS. S. Heimann, New York, N. Y., 565,269. Filed Feb. 29, 1896.

A glass chimney, a metal ring surrounding the lower end of said chimney, a cylindrical metal frame in the lower end of which said ring fits snugly and a series of glass tubes, held longitudinally and side by side in said cylindrical frame.

Miscellaneous:—

ELECTRO-THERAPEUTIC APPARATUS. Henry E. Waite, New York, N. Y., 565,056. Filed April 2, 1894.

Comprises a room having a series of rods arranged about the walls, a series of devices adjustably mounted on the rods and carrying electrodes, and detachable connecting-bars for electrically connecting the rods.

ELECTRIC SAD-IRON. F. H. Date, J. Heffron, B. H. Scranton and J. Scudder, Detroit, Mich., 565,136. Filed May 31, 1895.

Current is automatically cut out when not in use.

ELECTRIC SOLDERING IRON. F. H. Date, John Heffron, J. Scudder and B. H. Scranton, Detroit, Mich., 565,137. Filed July 18, 1895.

Similar to above.

ELECTROLYSIS. Henry Blumenberg, Jr., Wakefield, N. Y., 565,-324. Filed Jan. 10, 1895.

Relates to the production of an oxysalt or chlorate from the corresponding haloid salt or chlorid by electrolysis.

MEANS FOR DESTROYING INSECTS OR MICROBES ON PLANTS. Jean Fuchs, Porto Ferrajo, Italy, 565,384. Filed Jan. 17, 1896.

A needle provided with a binding-post and inserted in the plant and connected to a conductor connected with a source of electricity and a rod buried in the earth and connected by a conductor to a source of electricity.

Railway Appliances:—

RAIL-BOND. Frank E. Buxton, Worcester, Mass., 564,968. Filed Nov. 29, 1895.

A bond wire with terminals diminishing in cross-section.

DEVICE FOR SUSPENDING AND SUPPORTING TROLLEY WIRES. Charles H. Fisk, Washington Court House, O., 564,984. Filed Feb. 23, 1895.

Consists of two main divisions and a washer, so formed that in connection with a means to tighten the collar on the washer the device will tightly grasp the wire.

CONDUIT FOR ELECTRIC RAILWAYS. Charles D. Mattison, New York, N. Y., 565,085. Filed Feb. 23, 1892.

A sectional conduit system supplying automatic contacts.

ELECTRIC RAILWAY. Henry Brandenburg, Chicago, Ill., 565,102. Filed May 16, 1895.

Conduit system.

ELECTRIC RAILWAY. Henry Brandenburg, Chicago, Ill., 565,103. Filed Aug. 28, 1895.

Provides a sub-conduit to receive débris passing through the conduit proper.

ELECTRIC MOTOR. J. Conner, J. R. MacMillan and A. J. Fuller, Philadelphia, Pa., 565,155. Filed Sept. 17, 1895.

A device for preventing lateral movement of the motor-frame.

TROLLEY-WIRE SUPPORT. Louis McCarthy, Boston, Mass., 565,-174. Filed July 20, 1894.

The wire is held by a yielding support which permits it to respond to vibrations.

UNDERGROUND-TROLLEY SYSTEM. R. E. Sherman and D. E. Kenyon, Chicago, Ill., 565,240. Filed Nov. 12, 1895.

Comprises a slotted conduit, a housing therein containing longitudinal slotted tubular openings for the conductors of the line and a bifurcated trolley device.

ELECTRIC LOCOMOTIVE. R. Eickemeyer, Yonkers, N. Y., 565,-407. Filed Dec. 30, 1889.

Especially adapted to be operated by storage batteries.

Regulations:—

ELECTRICAL GOVERNOR. Mark A. Replogle, Cedar Falls, Ia., 565,032. Filed Jan. 26, 1894.

Details of construction.

DISTRIBUTION AND REGULATION OF POWER. Horace B. Gale, San Francisco, Cal., 565,138. Filed June 17, 1895.

Consists in coupling, with each prime motor to be regulated, a dynamo electric machine arranged to absorb superfluous energy from the motor and to supply energy when deficient.

METHOD OF AND MEANS FOR ELECTRIC REGULATION OF POWER. Horace B. Gale, New York, 565,139. Filed Jan. 15, 1896.

Similar to above.

Switches, Cut-Outs etc.:—

CIRCUIT-BREAKER. W. B. Tobey and H. W. Smith, Pittsfield, Mass., 565244. Filed Aug. 28, 1895.

Consists of spring-actuated normally closed shutters of insulating material, contact plates in their contiguous surfaces, a blade acting as a wedge for forcing apart the shutters when brought into engagement with the contact-plates, said shutters being adapted to close when the blade is withdrawn.

Telegraphs:—

COMBINED TYPEWRITER AND TELEGRAPHIC TRANSMITTER. C. E. Yetman, Oak Park, Ill., 565,128. Filed Sept. 7, 1895.

Designed to unite an ordinary typewriter machine having a series of finger-keys to actuate the type-bars, with an electric code-transmitter governed from the same keys.

Telephones:—

TELEPHONE SWITCHBOARD. Alfred Stromberg and Androv Carlson, Chicago, Ill., 565,046. Filed Oct. 29, 1895.

Details of construction.

TELEPHONE SUBSTATION APPARATUS. A. De Khotinsky, Boston, Mass., 565,080. Filed May 23, 1896.

Relates to apparatus used at a subscriber's station in a telephone system in which the telephone transmitter and signal-sending device have a common source of current supply.

TELEPHONING FROM CARS. Manious Garl, Akron, O., 565,385. Filed Jan. 10, 1896.

Embodies a portable pole provided with curved arms, in combination with a portable telephone and fixed telephone.

TELEPHONY AND TELEGRAPHY.

THE TELEGRAPH IN ITALY.

According to the official returns of the Italian Ministry of Posts and Telegraphs, the number of messages sent over the wires during the last half-year of 1895 was 22,002,206. This includes dispatches on the Red Sea line (Massowa and Assab).

THE TELEPHONE IN RUSSIA.

It has been determined that the telephone line which was put up between St. Petersburg and Moscow on the occasion of the recent coronation festivities shall be allowed to remain, and shall be available for use by the general public. On the subject of the development of telephonic communication in Russia, the "St. Petersburger Zeitung" says that the introduction of the telephone exchange system dates from 1882, when concessions were granted to a company for the establishment of telephonic systems in St. Petersburg, Moscow, Warsaw, Odessa, and Riga. There were several concessions to companies or private undertakers in the succeeding years, and in 1884 the first government system was established at Kieff, though there had been previous installations in connection with the St. Petersburg palaces. After that progress was rapid, so that by 1895 forty-one additional town systems had been established, and at present all the larger towns of the empire are provided with a properly-equipped exchange. As to subscribers, the list is naturally headed by St. Petersburg, with 2,230 in July, 1895; but as the number the year before was 1,977 there has probably been a considerable increase by this time. Such places as Baku and Nishni-Novgorod have 502 and 367 subscribers; the smallest is Berdiansk, with 30 only. The aggregate for the empire was, in 1895, 9,007 subscribers on companies' and 6,111 on government systems, while the corresponding figures for the previous year were 8,004 and 3,958. This shows a considerable augmentation, and there has been a corresponding increase in the length of lines during the year. Trunk-line work is naturally more backward, since the distances in Russia are so much greater than in other European countries. The trunk lines between Rostoff and Taganrog and Odessa and Nicolaieff may be mentioned. Besides all that have been referred to above, there are, of course, a quantity of purely private telephone installations serving factories and so on, but not connected with any central exchange.

BELL TELEPHONE STATEMENT.

The statement of the Bell Telephone Company for the month ending July 20, and from Jan. 1 to July 20, compares as follows with the report for the corresponding periods in 1895:

Month.	1896.	Changes.	
Gross output	12,584	Dec.	1,253
Net output	2,094	Dec.	4,230
Jan. 1 to July 20:			
Gross output	126,678	Inc.	27,782
Net output	73,011	Inc.	21,236

Total number of instruments under rental on July 20, 1896, was 747,987, against 634,281 in 1895.

H. STEVENS SONS COMPANY, of Macon, Ga., are making the conduits for the Atlanta Telephone Company's underground work. The specification calls for 4 and 6 three-inch hole conduits in 30-inch length with dowell pins for coupling them together. The conduits are made of clay, salt glazed.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE G. E. IMPROVED "M" AND "K" ARC LAMPS.

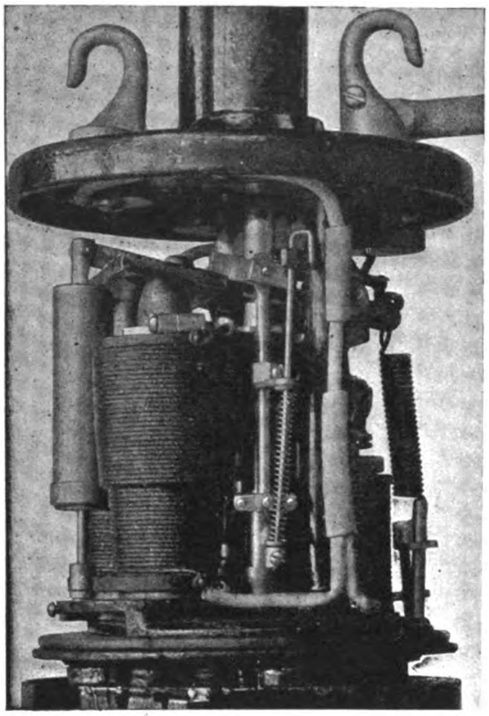
THE best arc lamp is that which gives the most and steadiest light at the least cost. Hundreds of men have tried their skill at designing lamps, but few have met the conditions stated above. The items whose sum makes up the cost of a lamp are: First, the original investment and the interest; second, the cost of current; third, the cost of carbons; fourth, the cost of trimming; fifth, the cost of inspection and repairs.

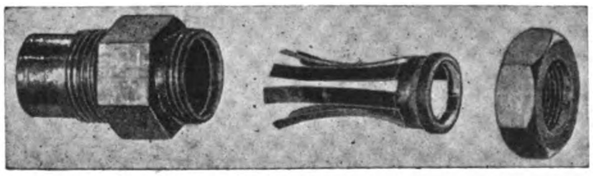
Assuming then that all series arc lamps give the same candle power for an equal current in the arc, we have five varying quantities to consider in judging what lamp to purchase and operate.

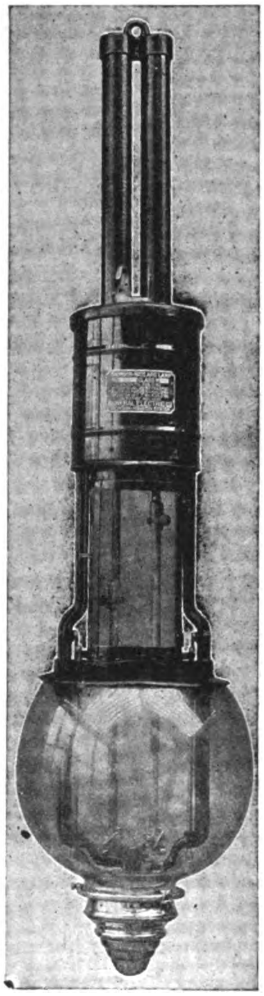
marked advantage over a poorly adjusted one. A lamp which can be supplied with the ordinary sizes and lengths of commercial carbons will prove cheaper in the end than one requiring special shapes and sizes.

Fourth. A large item in the cost of series arc lighting is often found in the expense of trimming. The time required to remove old carbons and insert new ones, to clean the globe, etc., varies widely with different makes of lamps. The ease of trimming also affects the third item of expense, as trimmers will not use special care in saving carbons when the shapes are different at top and bottom, but will throw away longs stubs that might otherwise have been used up profitably.

Fifth. The expense of keeping a lamp in good order is large or small, depending on the quality and design of the frame and mechanism. A simple arrangement of magnets and clutches enclosed in a water-proof case and with a frame which will not drop the globe is the ideal lamp, and the one which costs the least to keep in good running order.







THE G. E. IMPROVED "M" AND "K" ARC LAMP.

First. The original cost of a lamp is not a large item, and as a lamp higher in price may be more efficient and cheaper to operate than one of less cost, the price should not be the deciding feature.

Second. The cost of current for a lamp is not alone for that which passes between the carbon points, but includes all consumed in the magnets, the wiring, or in any part of the mechanism. The greater the lamp losses, the higher must the voltage be at the lamp terminals, and the greater the horsepower or kilowatt output of the generator. The starting current, when a whole circuit of lamps are thrown on together, is a serious matter with some lamps and stations, as it may be large enough to cause an excessive load on the machine with resultant stretching of belts, etc., or may make it almost impossible to start the whole series together.

Third. Carbons, while costing the same per inch for different lamps, may not cost anywhere near the same per candle power hour, the conditions of the feeding of the lamp and the accuracy of adjustment causing wide differences. A lamp that picks up quickly and feeds accurately will show a

The breakage of globes might almost be included under trimming expenses, as a majority of broken globes can be laid to the dropping of them by the trimmer, simply because the frame and globe holder construction makes it almost impossible to avoid such accidents.

The questions of expense are, however, not the only ones which affect the purchaser of arc lamps. The appearance of the lamp often has a considerable amount of influence. The external design of the lamp should harmonize with the place where it is installed; for general street use a plain unornamented frame is best in keeping with the poles, brackets and line construction generally employed. It is absurd to place highly ornamental lamps in situations where they can gather dust and dirt that will never be wiped off. Neither is it practical to attempt to adopt one ornamentation to all places, no matter what the character of the other decorations. An arc lamp should be taken for what it is, and should not be distorted in shape or lavishly carved and ornamented at a sacrifice of efficiency to style. Many makers of lamps have looked more to external than to internal characters, and have

produced extra short, extra narrow, or otherwise extraordinary lamps, whose chief merit is that they are cheap in first cost, and hence not expensive to scrap.

There are probably in use at present nearly 400,000 arc lamps, and three-quarters of them certainly are of the clutch type with smooth cylindrical carbon rods. Illuminating companies are not wholly blind to their own interests, and the preponderance of this type of lamp indicates that their preference is for the clutch feed lamp. Whatever the theoretical disadvantages of the clutch, it certainly works well in practice, and has been in use long enough to outlive various rack, chain and ribbon feed lamps which have been offered as improvements. When this lamp is properly constructed, the trimming and adjustment are simple and easy, and the heat losses in the lamp, wiring and mechanism are small. Clutch feed lamps seem to work in all weathers as well as, or better than, more complicated types and no lamp should be exposed to all of the inclemency of the weather without suitable hoods, protectors or covers.

The length of the clutch type lamp has sometimes been urged as an objection, but when we consider the adavntages in operation over other types and the fact that the majority of these are installed out of doors, this objection loses its force. A double carbon standard lamp burns for sixteen hours without retrimming, and if a shorter lamp is needed, a double lamp to burn eight hours is readily obtained. Most installations, however, now combine arc and incandescent circuits, and clutch arc lamps adopted for 100 or 150 hours run on incandescent circuits can be had at a low price.

There are a lot of imaginary difficulties in clutch lamps and a great number of real troubles with some other types. There are good rack feed lamps, but they are not adapted for series circuits. Certain makers propose to do away with the sliding contact on the carbon rods, but introduce worse features in the way of flexible conducting cords or chains which make the feed sluggish and unsteady. The carbon rods themselves are denounced as needlessly long and entirely unnecessary, yet it is believed that no series lamp has been commercially successful without them. The needs of series lighting require that a lamp feed shall respond instantly to any changes in current, and only an extremely simple and free working feed can do this.

Instead of trying new devices, one company has devoted its attention to perfecting the original clutch type lamp, and has recently introduced several improvements in series lamps of this type. These improvements are shown in the accompanying illustrations, and will be found of interest to all concerned in series arc lighting. These improved lamps operate on either 6.8 or 9.6 ampere circuits without change in adjustment. That is, the same lamp may be used for 1,200 candle-power or 2,000 candle-power. This improvement is gained by a special winding on the combination magnets, and an entirely new "bridge contact" which is sensitive and positive in action, and free from destructive sparking. It makes the lamp pick up instantly and does away with sputtering and hissing carbons.

The feeding clutch will immediately attract the attention of lamp users. It is light, durable and may be adjusted without removal from the lamp. This is done by means of an adjusting screw easily reached by a screw-driver and locked by a check nut. The clutch tension spring is insulated and thus protected from annealing, which sometimes occurs in springs subjected to the passage of current.

The combination magnets may be removed quickly from the lamp by unscrewing a strap which forms a part of the rocker frame. Other parts of the mechanism need not be removed in the operation. All moving parts, except the carbon rods, are nickel-plated. This gives a very clean cut appearance to the interior of the lamp, and is thorough protection from corrosion.

The lamp is made dust-proof by the enclosing cylinder, which has an internal shoulder fitting snugly against the base plate. The side springs for holding the cylinder in place have been discarded. The top of the lamp has been made water-proof by tightly fitting chimney base. The lower frame is adapted to an improved globe lowering device, and the shadows cast by the frame are reduced materially. The dust pan has been done away with, and a dust cup takes its place at the lowest point of the globe holder. This catches all dust, and may be removed readily from the lamp. It is much easier to keep lamps clean with this device than ever before.

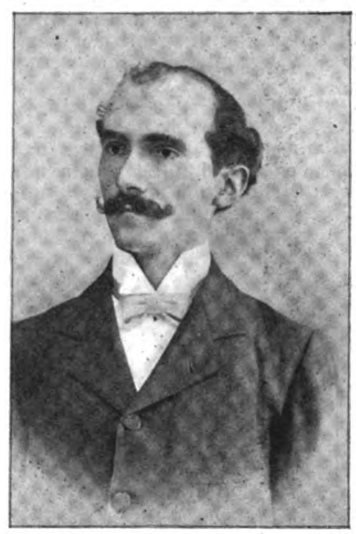
One of the greatest improvements in these lamps, and one which will appeal strongly to the trimmer and to the one who pays for broken globes, is the globe lowering device. By means of this the globe is lowered with the greatest ease to a point several inches lower than on earlier styles of lamp, and is held securely in this position while the lamp is being trimmed. In its normal raised position it is held firmly in place by a simple latch which cannot be lifted to release the globe until the globe itself is raised slightly from underneath. This insures a support from below at the time when the latch is withdrawn, and prevents the globes from being accidentally dropped and broken. The simplicity and reliability of this device together with its great convenience appeal at once to the practical trimmer.

No change in the size of carbons has been made, but in the full length double lamp, lower carbons may be used, the extra length projecting through the lower carbon holder into the dust cup from which it is electrically protected by suitable insulation. At the second trimming, these carbons may be raised, and the stubs used for the next run. The weight of the single carbon lamp is 25 lbs., and of the double carbon lamp, 30 lbs.

In bringing out these improvements, care has been taken to make each new part interchangeable with the corresponding part of the old lamps of the same make. This is an excellent point, as it allows those who have the earlier style of lamps to introduce into them such of the improved parts as they desire instead of having to abandon entire lamps for the sake of obtaining the improved features of the new.

These lamps, which are manufactured by the General Electric Company, have been designated the improved "M" and "K" respectively, and correspond to the former double and single carbon lamps of the same company.

MR. V. J. MIRANDA.



Mr. V. J. Miranda.

The first lecture and demonstration of the X-rays given in South America was by Mr. V. J. Miranda on July 5, at the Government Theatre at Pará, Brazil. The fluoroscope was also presented for the first time in that country at this lecture. Mr. Miranda is a graduate of Columbia College, electrical department, and afterwards worked in the shops of the Thomson-Houston Company, at Lynn, Mass.

He installed the electric lighting plant in the Government Theatre, Pará, Brazil, which has been in operation for the last three years. The two dynamos and all the electrical material were of the Western Electric Company's make, and the plant is driven by two MacIntosh & Seymour engines. Mr. Miranda now has a contract for the equipment of the new theatre at Manaos on the Amazon river. The plant will contain 2,000 incandescent and sixteen ornamental arc lights. Western Electric dynamos and Armington & Sims engines will be used.

X-RAY APPARATUS.

Mr. J. A. Le Roy, 143 East Thirteenth street, New York City, is supplying complete outfits for X-ray photography, including fluoroscopes. The action of the heart has been plainly seen with the instruments he furnishes, also the bones of the body, the liver and the denser organs have been readily traced. Owing of these facts the demand for the very best apparatus has become imperative.

This apparatus is fully tested before shipment, and is guaranteed in perfect working order, and it does not need an electrician to operate it. Mr. Le Roy publishes in his catalogue a number of testimonials in regard to his apparatus from well-known physicians and professional men.

ELECTRIC LIGHTING IN GUATEMALA.

We are informed by Messrs. Morehouse & Morril, engineers, of Quezaltenango, Guatemala, that they have taken a contract to furnish a complete hydraulic and electric plant for the lighting of the city of Antigua, close to Guatemala city. The contract price is $70,000. Mr. Morehouse has left for San Francisco, where he will purchase the supplies, machinery, etc., for this work.

THE SCOTT & JANNEY ELECTRIC & MFG. CO. are meeting with good success with their new alternating desk and ceiling fans.

THE NATIONAL ELECTRIC HEADLIGHT.

The most important recent application of the electric headlight manufactured by the National Electric Headlight Company of Indianapolis, Ind., is on Dr. Seward Webb's private car and engine, Ne-ha-sa-ne. He speaks in very complimentary terms as to the successful operation and value of the electric headlight.

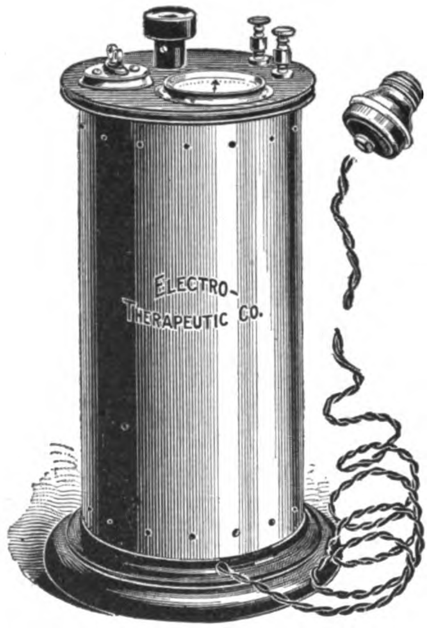
Perhaps the most ambitious railroad man in these times is Mr. E. H. Greene, the only son of Mrs. Hetty Greene, of New York. Mr. Greene is president and general manager of the Texas Midland R. R., a short road of 53 miles. The rolling stock of his road consists of the very finest that can be bought. He now has five of these electric headlights.

The company have established a branch office in the Monadnock Building, Chicago, with Mr. R. C. Vilas as the sole dealer and Mr. Mark A. Ross, late of the National Tube Works, St. Louis, as his sales agent. They have all the business they can attend to and have lately made a 100 per cent. addition to their working force.

THE WHEELER FRACTIONAL VOLT-SELECTOR.

THE G. M. WHEELER fractional volt-selector has become recognized as one of the standard apparatus for all cataphoric operations because of its capacity for controling the electric current so as to preclude all danger from painful shocks of any degree, even when the electricity is applied to the most sensitive parts of the body. It is being used by eye, ear and throat specialists, by dentists and others with entire success; either with the 110 volt street circuit or with a battery, proving in all cases a practicable and scientific instrument.

The principles involved in the administration of medicines, and of producing anaesthesia, by cataphoresis, have been known for many years, but their adoption and use by surgeons, dentists and physicians generally, has been delayed until very recently, because the instruments and apparatus for applying electricity without giving the patient a painful



THE WHEELER VOLT-SELECTOR.

shock have not been available until the fractional volt selector was constructed.

By it the current is permitted to flow over the patient's circuit only as the operator of the instrument may think necessary under the conditions which are offered by the patient: and so minute is the increase of the pressure of the current that the patient can feel no pain.

There are some features in this fractional volt selector which are similar to those of ordinary rheostats used in electro-therapeutics, but it is not a mere rheostat for it possesses powers and involves principles which remove it far beyond the definition of a rheostat. The illustration shows its external appearance, with its various parts and connections. Its weight is only about five pounds, and withal it is an attractive and valuable apparatus. The instrument is manufactured by the Electro-Therapeutic Company, 120 West Forty-fourth street, New York, who also make a variety of electro-therapeutic apparatus.

THE RAINBOW BELT.

The Peerless Rubber Manufacturing Company, 16 Warren street, New York City, are manufacturing a line of belting, the composition of which is practically the same as that of their Rainbow packing compound. It is made in an entirely

different manner from the ordinary rubber belt, inasmuch as it is composed entirely of but one piece.

This belt is intended particularly for electrical, saw mill and paper mill service, and is constructed with a view to running very true, which is particularly necessary for these classes of work. It is constructed in a mould, and afterwards pressed in a special machine.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY have taken the general Western agency for the Boudreaux dynamo brush, and are carrying a complete stock in Chicago. These brushes are used almost exclusively by the United States Government, and by the largest manufacturers of electrical machinery in the United States.

THE CALLENDER TELEPHONE EXCHANGE COMPANY, of Brantford, Canada, whose highly ingenious system of automatic exchange apparatus was illustrated recently are now fully prepared to undertake contracts for the installation of their system. As soon as the demand warrants it the company will establish a factory in the United States. By the Callender system, it will be recalled, all operations at the central office are performed automatically, no operators being necessary.

THE AULTMAN & TAYLOR MACHINERY CO., of Mansfield, O., have issued a pamphlet containing a report of tests on the Cahall boiler which they manufacture. The tests were carried on by Mr. Thomas Pray, Jr., of Boston, upon a boiler belonging to the plant of the Armstrong Cork Company, of Pittsburg, Pa. The boiler in question was a Cahall patent vertical water tube boiler, in connection with which was a Hawley down draft furnace. The tests showed the efficiency of the boiler performance in percentage of the theoretical value of the coal consumed to be 85.862 per cent. The company will be pleased to furnish the pamphlet containing the report to anyone interested in boiler performances.

NEW YORK NOTES.

MR. ELIAS E. RIES, formerly of Baltimore, has opened an office as consulting electrical engineer at 4 West 115th street.

BREWSTER ENGINEERING CO. have booked some very large orders this week for the Belknap woven wire brushes. They are also compelled to run their electric moulding factory over time in order to keep up with their orders.

MR. W. C. ARMSTRONG, for many years a well-known figure in the line of open arc lamps, has realized the great advantages of enclosed arc lighting for various uses and has lately connected himself with the sales department of the "Pioneer" lamp concern. His offices are with the Electric Arc Light Company, 687 and 689 Broadway, where he will be glad to show his friends the new wonder. He reports good sales and a cordial reception for the "Pioneer" in all circles.

PHILADELPHIA NOTES.

VALLEE BROS. & CO. report the largest sales last month of any month since their company was formed.

MESSRS. MANSFIELD & BAIN, agents for the Walker Co., have removed from the Betz Building to 748 Drexel Building.

THE DIAMOND STATE HARD FIBRE CO. of Elsmere, Del., have recently increased their plant and are running to their full capacity.

Department News Items will be found in advertising pages.

THE

Electrical Engineer.

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MISCELLANEOUS.

ELECTRICAL FEATURES OF THE GENEVA EXPOSITION.

WHILE it does not appear likely that the General Electrical Congress will have much effect on the course of events by its work, it is at least consolatory to know that the electrical exhibits at the Swiss National Exposition, at Geneva, this year, have made a very favorable impression on the visitors to that interesting display of Swiss ingenuity and resources. The Exposition, though not small, lays no special claim to admiration on the score of its bigness; but in tastefulness of arrangement and in the high quality and excellence of its exhibits, it has certainly never been surpassed. In electrical machinery, as in all that pertains to hydraulics and horology, Switzerland stands in the front rank, and the brilliant exemplifications afforded at Geneva this year, in these various fields, furnish much pleasure and instruction to every visitor.

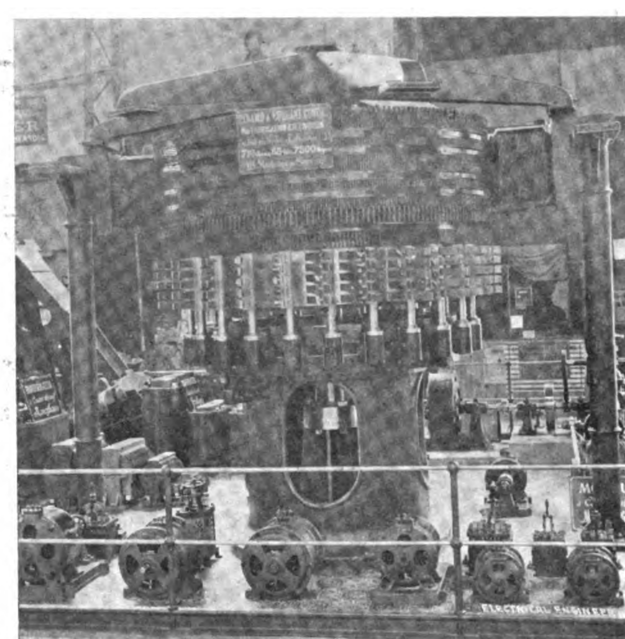
Theodore Turrettini.

For electrical engineers it will suffice to say that the president of the Exposition is Colonel Theodore Turrettini, Mayor of Geneva, the distinguished engineer whose name is associated alike with the utilization of the energy of the Rhone at Geneva and with the recent work at Niagara. Since 1894, the destinies of the Exposition have been in his hands, and the results are most satisfactory. With him have collaborated as directors and officials leading Switzers in all professions, the various committees for the 47 groups comprising no fewer than 600 persons of prominence and influence. The Exposition itself occupies a large stretch of ground on the southwestern side of the city adjoining the Boulevard de Plainpalais, and covers about 450,000 square metres, all told. It is bisected by the rushing and sparkling Arve on its way to join the Rhone just below the city; and it is reached very conveniently from the city by trolley cars that deposit the visitor right at the Plainpalais gates.

It is needless here to describe all the features of this Exposition, and the intention is to refer only to one or two of the more striking electrical elements of the show. In the first place it may be noted that as at all modern expositions of the first rank, the lighting is done by electricity, although entrance at night time is restricted to one or two buildings and to the beautiful and idyllic Swiss village. Outside the Fine Arts Palace, near the entrance, is a fine fountain so arranged as to be illuminated electrically with fine effect from beneath. There is a track contact electric railway making a circuit of the grounds, and an electric tower 165 metres high, furnished with two electric elevators and with an American bar at top and bottom. The main feature, of course, electrically considered, is the machinery hall, but the distribution of power by means of motors is on a very large and impressive scale.

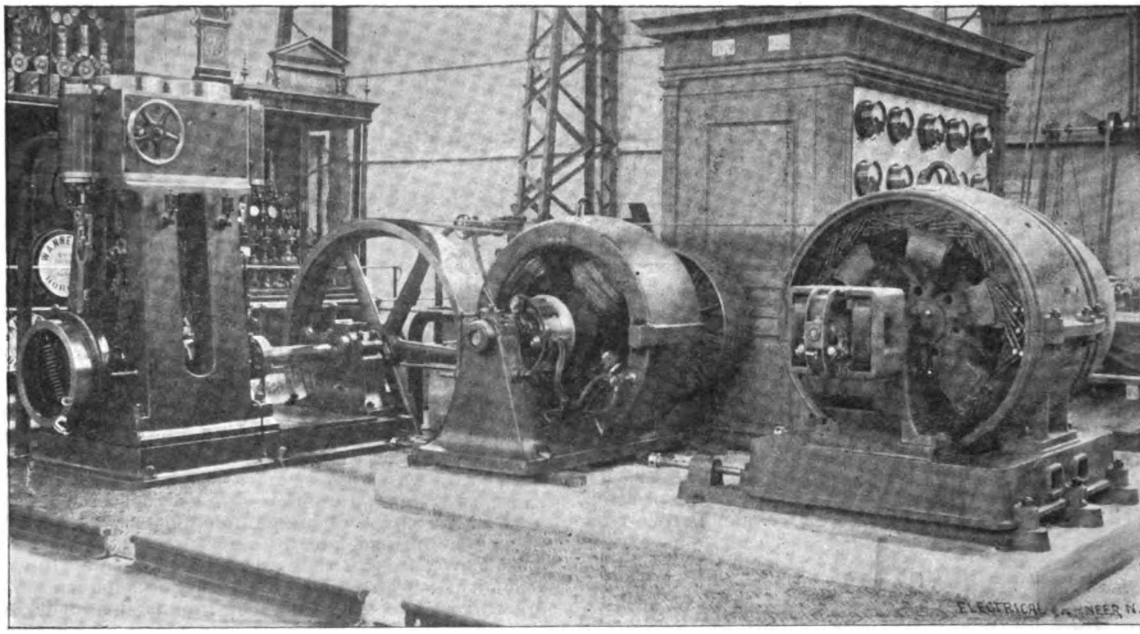
Exteriorly, the machinery hall is not beautiful, resembling a railway station with its circular or dome roof, but inwardly it is admirable. It is the most important of all the exposition buildings and was designed by Mr. E. Phelps, architect, the contractors being Theodore Bell & Co., of Kriens. It is built almost wholly of steel. The length is 150 metres and the width 88. It is divided into three naves, the central one being 35 metres in width, while the two others are each 25 metres. A very large part of this building is occupied by the electrical exhibits, embraced in group 38, the heavy apparatus for light and power being flanked by water power machinery and by street cars and light railways, while on another side are to be found smaller apparatus in the shape of lamps, telephones and telegraphs, batteries, push buttons, etc.

It is well known that an extensive use of the power of the Rhone has been made by the city of Geneva. The electrical apparatus is of the Thury continuous current design, to which reference has frequently been made in these columns; and a fine exhibit is made of it not only by the city, but by the manufacturers of it, the Compagnie de l'Industrie Electrique. This concern has supplied the Schuckert and Grazier arc lamps employed in lighting the grounds and for display work. It has also in operation a fine electric crane which travels the length of machinery hall and on which the public can ride if it pays a small fee, just in the same way as at Paris and Chicago. The pumps for the illuminated fountain are also driven by this company's motors, and in the very interesting pavilion of Raoul Pictet just back of the hall, a number of motors are driven, current being furnished by a 150 ampere series Thury generator. The exhibit includes also a compound wound street railway generator belt driven, and a two-phase synchronous motor wound so as to be able also to supply continuous current if run as a rotary transformer. It may be here noted in passing that the machinery in the hall is driven in various ways, there



OERLIKON GENERATOR WITH VERTICAL AXIS FOR ALUMINUM PRODUCTION.

being 145 horse-power of hydraulic motors, 450 horse-power of steam, and 500 horse-power of electricity, part of the current being derived from the city plant. It will be remembered that Mr. Thury has for many years made a specialty of continuous current long distance power transmission, and one familiar



Part of Oerlikon Exhibit at the Geneva Exposition.—Direct and Alternating Dynamos.

Interior, Machinery Hall, Geneva Exposition, Showing the Traveling Crane of the Compagnie De L'Industrie Electrique.

instance is that of Genoa. Another striking case is that of the transmission of 400 horse-power from Rondchatel to Biberist, a distance of 28 kilometres. When it is stated that the voltage in such work is carried up to 7,000 volts it will be seen that the insulation and general construction of the machines is necessarily of a very high type.

The exhibit of the Oerlikon Machine Works is remarkably fine, being at once large, representative and interesting. Although it includes continuous current apparatus, it may be said to demonstrate the success of the Swiss in alternating current work. The space occupied by the exhibit proper is no less than 365 square metres, but the works have motors scattered all over the exposition running machinery of different classes. Two illustrations are here given of some of the apparatus, one picture including a direct current generator of 80 horse-power, at 220 volts, and a 100 horse-power, 3-phase generator. The other cut shows a direct current generator for the production of aluminum. The shaft is vertical so as to be coupled to a turbine below. Each of these generators gives 710 horse-power (7,500 amperes at 65 volts) when running at 150 revolutions per minute. In the cut, some of the field magnets are seen removed from the spider, the object being to expose to view the construction of the armature. The Oerlikon works have made a specialty of this apparatus, and the number of orders received would imply that the quantity of aluminum made is greatly on the increase.

It is, however, as already noted, in alternating current apparatus that the works have made so fine a display. They have a single-phase alternator in the space of Escher, Wyss & Co., of 230 horse-power and 2,400 volts; also a triphase of 100 horse-power and 200 volts. There is also a triphase alternator of 20 horse-power at 110 volts, also coupled to an Escher & Wyss turbine. It is not generally known that the works build steam engines, but the exhibit includes an engine of vertical type driving a 4-pole continuous current generator; and part of the field magnet is shown of a dynamo which will constitute part of a direct coupled slow-speed unit. The Oerlikon motors are all over the place, and are also attached to a number of tools within the exhibit. A notable exhibit of weaving machinery in the Ruti exhibit is run by Oerlikon motors which can be run either by a generator driven by a Laval steam turbine or by the small 20 horse-power alternator driven by the Escher & Wyss turbine. The continuous current motors are driven by the two generators operated by steam engine, and the monophase and biphase motors used by a number of exhibitors take current from the power service of the exposition. The company's monophase motors range from one-twentieth up to 6 horse-power, and the triphase from one-third up to 36 horse-power. The motor driven tools in the company's exhibit are quite interesting and include a pivotal crane equal to lifting 5 tons; a horizontal ribbon saw operated by triphase motors; machines for cutting saw teeth; boring and drilling machinery for metal working; portable drill; boring machines for stone and coal cutting, driven by triphase motors; portable ventilators; planing machines, etc. In the exhibit of the Gotthardbahn (Gotthard Railway) are photographs of Oerlikon motor tools employed in its shops at Bellinzona; and the Swiss Military Department shows in the Military Park a movable projector for night operations.

Among other exhibits to be mentioned in passing are those of Alioth, of Basle, and the Société Suisse of Neuhausen, whose street cars are of interest. The Swiss Department of Posts and Telegraphs has a fine special exhibit in which every single detail of line construction and of operation is grouped and exposed, in a most instructive manner. Reference has already been made to the Pictet exhibit, where electrical machinery assists in the production of liquid air and extreme cold, and where electric light is seen in contrast with Mr. Pictet's acetylene gas. In the Agricultural Group also is to be found the alarm apparatus pertinent to the fire service, and the groups of instruction and meteorology also include much of interest to electricians.

The little electric railway that encircles the grounds is a modest affair, and on that score not to be harshly criticised. It is true there are no overhead wires, but it offers no really valuable suggestion as to a substitute. The car is a small one, and the light rails are supported on wooden insulating blocks. The current, at 100 volts, passes into the motor by one rail and back to the other rail, so that a dead short circuit would be an easy matter. The potential is only 100 volts, but it is said that the leakage on wet days will run up to 50 amperes, which should ordinarily be enough to run the car itself. Still, the road does its work very well and gets lots of patronage. The visitor who takes it as soon as he enters the gates gets at once an excellent idea of the disposition of the buildings and the main points of interest. It is, however, to the road up Mont Salève that the trip must be taken if one would see the boldness of Swiss enterprise in railway work. This road, on the third rail plan, climbs to an altitude of 4,000 feet, by means of single and double rack rails in the center of the track; and while one can look down northward on Geneva and Lake Leman the southward range of vision includes long terraces of snowy Alps and the huge white shoulders and peak of Mont Blanc itself.

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES—V.

BY J. A. FLEMING, M. A., D. SC., F. R. S., M. R. I.

By subjecting a hard iron ring to frequent reversals of the same magnetizing force whilst it is cooled up slowly from the temperature of liquid air up to ordinary temperatures, we have been able to trace the gradual decrease of the permeability at any constant force throughout this range of temperature.

We have found, on the other hand, that unhardened steel pianoforte wire behaves like soft annealed iron.

We have, then, examined the hysteresis of iron at low temperatures (Fig. 12).

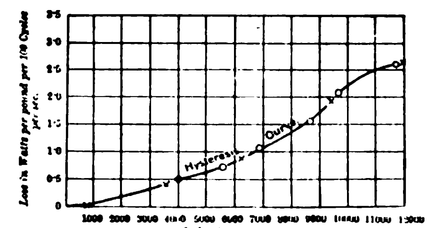


FIG. 12.

As the meaning of that term was very fully explained by the inventor of it in a discourse given quite recently, no time need be spent in an elaborate explanation of it. It is sufficient to say that when iron is magnetized and demagnetized or carried round a cycle of magnetization in which its direction of magnetization is first in one direction and then in the other, this process involves the expenditure of energy, and such dissipation of energy is spoken of as the hysteresis loss in iron. It would occupy too much time to attempt to explain in full detail the manner in which this dissipated energy can be measured. As a matter of fact, the method we adopted was the laborious but exact one of delineating a complete magnetization curve of the iron, by means of observations taken, with the ballistic galvanometer for various maximum values of the magnetizing force. In this way we were able, finally, to arrive at a curve which represented by its ordinates the value of the hysteresis loss in the iron in ergs per cubic centimetre per cycle, and the abscissæ the maximum value of the corresponding magnetic induction. When curves had been drawn out from all the many hundreds of observations for the case of the same soft-iron ring at ordinary temperatures and at the temperatures of liquid air, we found little or no sensible difference between them. The result is, then, that there is no appreciable change in the magnetic hysteresis loss of very carefully annealed soft Swedish iron when cooled to these low temperatures. With regard to the hard iron, although the permeability is increased, it is most difficult to say yet whether the hysteresis is increased or not, as every fresh reduction in temperature of the iron alters its physical state,

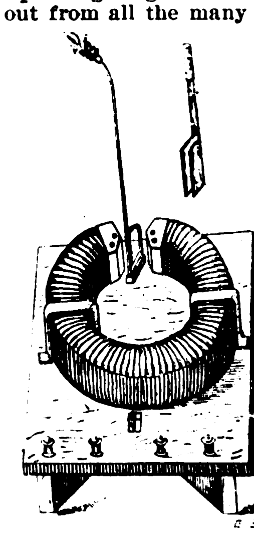


FIG. 13.

and makes it almost impossible to obtain similar repeated measurements.

It is natural to inquire how far accepted theories of magnetic action are able to reconcile the above-mentioned results. Some of them undoubtedly are in accord with deductions from received hypotheses.

It is generally considered that the facts connected with the magnetization of iron indicate that each molecule—or, perhaps, small groups of molecules—of the iron are complete micro-magnets, and that in the unmagnetized condition of the iron these molecular magnets arrange themselves in groups or in closed circuits; so that for each little group the external magnetic action or magnetic moment is approximately zero. Magnetization consists in arranging the members of some or all of those groups so as to collineate the direction of more or less of the molecular magnets and produce an external resultant magnetic moment.

Let us, then, consider one such little group by the aid of a model made of small magnets (Fig. 13), such as Ewing has suggested and used. Suppose the members of this group to be at a certain distance from each other, and we apply a given magnetizing force which is just sufficient to open out the group and co-lineate the magnetic axes of the several members of it. Next, suppose we cool this iron; this would result in bringing the members of the group into closer contiguity. The result of this will be an increase of the interpolar magnetic forces of the different members of the group, and as we can see from the behavior of the model, it would require a greater magnetic force to effect the same amount of collineation of the molecular magnets. This, however, corresponds with what we find to be the case on cooling soft iron to very low temperatures. Professor Dewar's experiments have shown that the tensile strength of iron and steel is increased to about double on cooling to —182 deg. C., and it is quite reasonable to suppose that this result is in part at least due to an approximation of the molecules.

As regards the behavior of magnets when cooled, it is highly likely that when the groups of molecular magnets have been opened out more or less that some of these are in a condition of instability, in which bringing the members of the group nearer together will have the effect of making them close up again into magnetic circuits of no external action. Hence, if this is the case, the first effect of the sudden cooling will be to effect the change. These half-hearted groups of molecular magnets constitute the sub-permanent magnetism which it is our desire to get rid of in ageing a magnet. Then, as regards the effect of temperature changes on the magnet when the stable condition of affairs is reached. In order to explain this, I think we must consider the action of the molecular groups upon each other. The approximation of molecular groups will in general, after the magnet is aged, have the effect of collineating more completely the different members of the groups, and hence increase the magnetic moment of the magnet, whilst the separation of the molecular groups and the reverse effects ensue on heating. The action of the low temperatures upon soft iron and upon magnetized steel would be explicable if we may legitimately make the assumption that lowering the temperature approximates the molecular groups and also the members of each group. The result of this in the case of existing permanent magnetization is to close up more or less those groups which are in an unstable condition, but it increases the collineation in those groups in which the magnetic moment exceeds a certain value. Hence, in the case of the permanent magnet the first effect of sudden cooling is a compound effect; it consists in a great reduction of the magnetic moment of certain unstable groups, but in an increase of moment of others. After this initial stage is past the normal effect is an increase of magnetic moment of the groups by bringing them closer together and a diminution by increase of distance.

There remains, then, to be explained the anomalous behavior of nickel steel and hardened iron, but the attempt to throw an inner light upon the results attained with these substances cannot possibly be successful until we have explored far more thoroughly at low temperatures the changes in their mechanical as well as magnetic qualities. However much we may be tempted to speculate upon the causes of these various changes in the properties of matter at very low temperatures, a much more important duty at the present time is the collection of facts and the completion of accurate quantitative measurements. The experimental difficulties of this low-temperature research are very great, but both Professor Dewar and I have been chiefly anxious in this particular work to prosecute preliminary explorations into as many regions of it as possible, these pioneering experiments enabling us to ascertain in what direction further inquiry will be profitable. Every step forward opens up fresh suggestions for investigation and, I may add, fresh difficulties. In the light of the results, however, thus ascertained we shall have additional means of testing and judging existing electrical theories, and the facts themselves when built into the fabric of scientific knowledge will serve to broaden those foundations on which we may profitably erect new hypotheses of electric and magnetic phenomena, which, even if they cannot dissipate entirely that mystery which enshrouds even the most familiar facts, will serve as a continual stimulus to thought and work in days and years that are yet to come.

ELECTRIC LIGHTING.

ELECTRIC LIGHTING IN BELFAST.[1]

BY VICTOR A. H. McCOWEN.

The Belfast Corporation, being the owners of the gasworks, and justly proud of the reputation they had gained of having their thoroughfares well lighted by gas, and the undertaking being also a paying concern, had no intention of allowing private companies to occupy the field. No fewer than seven of the latter in 1882 served notice of their intention to apply for provisional orders for power to supply electricity within the city. All these applications were successfully opposed; the Corporation remained in possession, and for seven years no further active steps were taken.

The Gas Committee was led to consider the question of the introduction of electric lighting. In September, 1889, they reported that in their opinion the time had arrived when the Council should obtain powers to supply electricity for lighting purposes, etc., within the city, and they also recommended that authority should be given to apply to the Board of Trade for a provisional order for that purpose. The Gas Committee were authorized to pay £50,000 out of the surplus profits of the gas undertaking towards the establishment of the electric light.

It was decided to obtain the assistance of a consulting engineer, and Prof. Alexander B. W. Kennedy, F.R.S., of London, was appointed. On account of the saving in capital cost, and other circumstances of the case, he recommended the system about to be described.

Area supplied.—The area at present supplied with electricity in Belfast, comprises probably the best part of the city. It includes first-class shops and offices, hotels, clubs, theatres, and churches; and of Howard street and College Square private houses.

As shops and offices together form a large percentage of the total consumption, the shape of the load curves depends greatly on their hours of closing. The distance of the farthest lamp from the station is as yet only about 800 yards, as the present area supplied with electricity is only a small part of the city.

Mode of Distribution.—The system of distribution is what is known as the three-wire low-tension. The current is supplied to consumers at 110 or 220 volts pressure. The distributing mains are connected up in a network, and fed at seven points by feeders from the generating station. The feeders deliver the current at the feeding points of the distributing mains at a pressure of 220 volts. The drop in the feeders at full load is 10 per cent. The pressure between the middle wire, and the positive or negative is 110 volts. Pilot wires are connected from the feeding points to voltmeters in the generating station, so that the switchboard attendant can always see what the pressure is at these points, and keep it constant by due regulation.

Charges and Pressures.—The charge for current for lighting is 7d. per Board of Trade unit, with discount ranging from 2½ to 17½ per cent. according to consumption; the maximum discount reduces the price to 5.77d. per unit. The charge for current for motors, heating, etc., in daylight hours, is 4d. per unit with the above discounts, of which the maximum reduces the price to 3.3d. per unit. Meter rents range upwards from 2s. 6d. per quarter, according to size. Installations containing over fifty lamps of 8 candle-power are wired either with single 220-volt lamps, or with pairs of 110-volt lamps in series, or on the three-wire system. Motors of over one horse-power are supplied with current at 220 volts. The meters in use are those of the Ferranti type.

Station.—The generating station is situated between Chapel Lane and Marquis street, within 250 yards of Castle Place, which is practically the center of the city; it is therefore a good position from which to distribute the supply. In the selection of the site, the question of convenience for delivery of coal, removal of refuse, etc., had not to be considered. The buildings were designed by Mr. C. Stanley Peach, of London. The shape of the site is rather irregular, and the space available has been made use of to the best advantage.

The engine room occupies the central and larger portion of the site, and measures 85 feet long by 33 feet wide at the east

[1] Abstract of a paper read before the Belfast Meeting of the Institution of Mechanical Engineers, July, 1896.

end and 44 feet at the west end. A 6-ton overhead traveling crane is provided, all the motions of which are actuated from below by means of ropes. The switchboard platform is raised about 4 feet above the floor level, and runs the whole length of the west wall of the engine room. The battery room, measuring 28 feet square, is situated between the engine room and the offices, on the same level; it contains four rows of stands for the cells, and is provided with ample means of ventilation. The offices occupy the west end of the site, with frontage to Marquis street. The meter-testing room and store room are above the offices on the first floor. A fitting shop and driver's room are placed at the east end of the building; and above them is the cooling tank, measuring 34½ by 12½ feet and 4 feet 2 inches deep.

Engine Room.—The plant in the engine room consists of the following engines and dynamos. Four 120 indicated horse-power tandem double-acting horizontal gas engines, running at 160 revolutions per minute, and driving, through eight ⅞-inch diameter cotton ropes, four 57.6 kilowatt dynamos of 240 amperes and 240 volts at a speed of 600 revolutions per minute. Two 60 indicated horse-power single-cylinder double-acting horizontal gas engines, running at 160 revolutions per minute, and driving through eight ¾-inch diameter cotton ropes two26.4 kilowatt dynamos at 750 revolutions per minute. Two 150 indicated horse-power four-cylinder single-acting high-speed vertical gas engines, running at 380 revolutions per minute, coupled direct to two 72 kilowatt dynamos of 300 amperes and 240 volts.

Switchboard.—The switchboard consists of five slates, each about 7 feet high; the center one is 36 inches wide, and the others 32 inches. All are bolted to an iron frame work, fixed on the switchboard platform about 4 feet from the engine room wall. The center slate carries the feeder and omnibus-bar voltmeters, the battery instruments and regulating gear, and the middle-wire ammeter and connections. The other four slates carry the feeder and dynamo instruments, switches, etc.: the two on the left hand are for the positive side of the system, and the two on the right hand for the negative side.

The machine and feeder bars, which are the vertical bars on the outer slates, are fixed on the front, and each is provided with three holes, through which a plug can be inserted to make connection with any one of the three omnibus bars that are fixed horizontally at the back of the board.

The automatic switches are arranged to break circuit should the current from the machine fall below 10 amperes. The shunt change-over switch is placed above the automatic, and connected with it by an interlocking lever. An ampere-hour meter is connected in the circuit of each dynamo, and registers the work done during a run, the readings being taken at start and finish. The voltmeters are Kelvin multi-cellular electrostatic, and are provided with multiple-contact switches. The feeder voltmeters show the pressure at any feeding point between the middle wire and the positive and negative wire. The bar voltmeters show the pressure between the positive and negative omnibus bars, and also between the middle wire and any of the omnibus bars. The dynamo voltmeters are used for showing the voltage of the machines before putting them on to the circuit.

The batteries are connected through their ampere-hour meters, polarized ampere meters, and emergency switches to the top omnibus bars. The usual practice at full load is to have all the machines and feeders plugged in parallel on this bar; but should it be necessary to run any particular pair of feeders at a different voltage, this can be done by plugging that pair of feeders and a machine on the bottom omnibus bar. As a a matter of fact, it has never been required to run a separate machine on a separate pair of feeders, as a very even drop all round is obtained.

The link connections are in the circuits of the small machines and are used for connecting them in the following different ways:—(a) As balancing machines on either side of the system; (b) as a special charging circuit for the batteries; (c) in parallel with the large machines across the system. The starting resistances and the shunt resistances are fixed in the cellar beneath the switchboard. The shunt regulating switches are fixed on the hand rail of the switchboard.

Battery.—The battery consists of 126 cells of the Electric Power and Storage Company's 34 K or heavy discharge type: sixty-three cells for the positive side of the system, and sixty-three cells for the negative. The capacity of each cell is 500 ampere hours, at a discharge rate of 100 amperes; the battery will, however, give a much higher rate of discharge for short periods. The plates are contained in lead boxes which are supported on wooden stands, being insulated from the latter by means of glass oil insulators. There are also eight hospital cells(which can either be used for assisting weak cells, or be put in series with the main battery. The connections from the battery in the regulator and switchboard consist of bare copper rods, supported by oil insulators suspended from the roof.

The method of regulating the battery is different from that usually practised, by cutting in or cutting out end cells. The regulation here is accomplished by putting the cells at the middle-wire end of the positive battery in parallel with those at the middle-wire end of the negative battery, the other ends of the batteries being connected through ammeters and emergency switches to their respective omnibus bars. The regulator is placed in the battery room, and is worked from a hand wheel on the switchboard by means of a rack and pinion. A reversible ampere-hour meter, which registers both charge and discharge, is connected in each battery circuit.

Dynamos.—The dynamos are by Messrs. Siemens Brothers, double-pole with drum armature and shunt-wound. The rope-driven machines are provided with heavy fly-wheels, and the larger ones have three bearings. The two small 26.4 kilowatt machines have double-wound armatures, each winding connected to a separate commutator. By means of a plug-board the armatures can be put in series or parallel, so that the machines can be run at 110 to 120 volts for balancing, or at 220 to 240 volts across the system. The voltage can also be increased to 270, if required. The rope-driven machines are placed close up to the back end of the back cylinder, to save floor space; and backward driving has been adopted, in order to get the slack of the ropes at top.

Gas Engines.—The six horizontal gas engines were manufactured by Messrs. Dick, Kerr & Co., Kilmarnock, under Hartley and Kerr's system. The four larger are double-cylinder double-acting, with the cylinders working tandem and the two pistons on the same rod, which is connected through cross-head and connecting rod to the crank. The bore of the back cylinder is 13¾ inches, and of the front 13½ inches; the stroke is 20 inches. The fly-wheel and driving wheel, one fixed on each end of the crank shaft, are each 8 feet 5 inches diameter, and weigh 37 cwt. and 29 cwt. respectively; the driving wheel is grooved for eight ⅞-inch ropes. These engines run at a speed of 160 revolutions per minute and indicate 120 horse-power; the number of explosions per minute is 320, or two per revolution.

The two smaller engines are single-cylinder double-acting; the cylinder is 13½ inches diameter and 20-inch stroke. They run at 160 revolutions per minute, and indicate 60 horse-power. The number of explosions per minute is 160, or one per revolution. The fly-wheel and driving wheel are each 7 feet diameter, and each weighs 57 cwt.

The cyclical variation in the speed of the tandem engines is very small, owing to the number of explosions, their low initial pressure, and their even distribution, the number of explosions being as 4 to 1 in comparison with a single-cylinder single acting engine.

There are four complete Otto cycles in two revolutions; and this work is continued right through the whole range of the engine load.

Governing.—The method of governing is different from that usually adopted of missing an explosion. With these engines the impulses are continuous, and are graduated according to the load.

With the tandem engines very steady working may be attained without running at a high speed. These engines were originally intended to work down to one-third of full load without missing an explosion; and it was thought that at lighter loads an explosion might be missed, and still sufficient steadiness be maintained. It was found, however, that the missing of an explosion at light loads affected the steadiness too much; and the adjustment of the engines was then taken in hand under the immediate personal supervision of Mr. Hartley, with the result of obtaining finely-graduated impulses, such as the writer believes have previously been unknown in gas engines. The engines are now capable of working from 20 per cent. overload down to no load, without missing an explosion. The word explosion seems here somewhat misapplied, when one considers the extremely low steady pressure all through the stroke.

Graduation of Explosions.—The difficulty to be overcome was the prompt ignition of the charge without initial shock, and under the difficult conditions of a rich charge varying down to an extremely poor one, and also to reduce the terminal pressure by more complete combustion in the cylinder. The charge ignites promptly and without shock, and the low terminal pressure shows that the charge is also utilized to the best advantage.

The quantity of air supplied to the cylinder is practically constant, the quantity of gas only is varied; and hence the difficulty of ignition. It is well known that a poor mixture of gas and air ignites slowly. The method adopted in certain experiments appears to indicate that stratification actually takes place in the gas engine cylinder, and that for certain purposes

it may be rendered of great use. The regularity of the ignition was attained by admitting gas to the cylinder later and later in the charging stroke; and even at full power a considerable quantity of air is drawn into the cylinder before gas is admitted. At light loads this results in the cylinder being almost full of air immediately following the piston, with only a small portion of rich and explosive mixture near the ignition chest. The ignition is controlled by a timing valve, which opens always at the same point of the stroke.

The gas charge is varied by a novel device, which is controlled by the governor. The gas valve is worked by an expanding cam, which may be described as an ordinary gas cam divided into three leaves in planes at right angles to the axis of the cam shaft. These three leaves are capable of being spread or closed by a sliding key, which slides in a keyway cut in the cam shaft, and is controlled by the governor. A helix upon the key engages the leading leaf of the cam; and when the key is moved longitudinally along the shaft in either direction by the governor, the cam is spread or closed as the case may be. The third leaf is fixed on the shaft, the middle leaf being loose on the shaft and having a slot in which works a pin fixed on the leading leaf. The key and cam are held in position by a detent driving the opening of the gas valve, but immediately it is fully opened the detent is released, leaving the cam again under the control of the governor. A Buss governor is employed, and the gas valves are gridiron slide valves; all other valves are of the mushroom type.

Ignition.—The method of ignition is by hot tubes, which are of ordinary wrought iron, nickel steel, and porcelain. The economical life of the wrought iron tubes is found to be rather short; after about fifteen hours the tube gets partially choked up, and gives late firing.

Lubrication and Packing.—The cylinders are provided with valve lubricators opening inwards; the oil is drawn in during the charging stroke. Asbestos packing is used for the piston-rod glands, and no trouble has occurred with hot rods, notwithstanding the high temperatures to which they are exposed; they are as bright and clean as those of a well-kept steam engine. The lubricant is ordinary gas-engine oil.

Cooling Water.—The cooling water from the overhead tank is circulated by means of small centrifugal pumps driven by belt from the crank shaft of each engine. The evaporation is made up through a ball cock valve connected with the tank, and supplied by the town water supply. The town water can also be mixed in any required proportion with the tank water. Separate connections are made to the cylinder cover and jackets; and regulating cocks are supplied for the necessary adjustments. When returned to the tank the water is discharged into a long timber shoot provided with a number of holes, by which is broken up into a shower, thus presenting a larger surface to the atmosphere, whereby the cooling is accelerated. This plan has been found of distinct advantage; and on few occasions has water been required from the town supply, even when running four or five engines together. The capacity of the tank is 10,700 gallons at 4 feet depth.

Gas Supply.—The gas is supplied through an 8-inch branch from the Corporation gas mains, brought into the station at the Chapel-lane end, and connected to three 500-light dry meters; the three are connected in parallel, and each is provided with a by-pass. The gas is conveyed from the meters through an 8-inch main, which runs the whole length of the engine room, supported by brackets on the columns. Each engine gets its supply from the main through a 3-inch branch pipe, provided with a valve and gas bag. The ignition gas is supplied through a separate pipe and meters. The horizontal engines each deliver their exhaust gases through 6-inch branch pipes into a common 18-inch exhaust main. A silencer is connected between the main and the uptake.

High-Speed Engines.—The high-speed vertical engines, which were manufactured by the Acme Gas Engine Company, of Glasgow, have four single-acting cylinders arranged in two lines of two in tandem, working on to opposite cranks. The pistons in the bottom cylinders form guides in the usual manner. The piston rod, connecting the top and bottom pistons, passes through a water-jacketed cylinder, the packing being ordinary Ramsbottom rings on the rod. The gas valves and mixture valves are of the mushroom type, actuated by means of cams. The piston valves, which control the exhaust and time the ignition, are worked from a small crank shaft fixed on the same level, and are parallel to the main crank shaft, being geared from it in the ratio 1 to 2 through steel spur and pinion. The cam shaft is also worked from this, through an upright shaft gearing with both.

These engines being of the closed-in type, the base forms an oil chamber in which the crank shaft works. The bottom pistons and the bottom piston valves are lubricated by the splash from the cranks. Lubricators are provided for the top cylinders only. The engine base is extended to take the dynamo, and the crank shaft is coupled direct to the armature shaft. A fly-wheel of 3 feet diameter is fixed on each end of the crank shaft, the one at the dynamo end weighing 28½ cwt. and the other 24½ cwt. Each cylinder is fitted with a stop valve, so that the engine can be run on one or more cylinders as desired. Each cylinder is provided with an ordinary pendulum type of governor; and the usual method of governing, by missing an explosion, is employed. Ignition is obtained by means of the hot tube. When the engine is running at full load, at its normal speed of 380 revolutions per minute and no explosions missed, 190 impulses per minute are obtained in each cylinder, or a total of 760 per minute in the engine. This, aided by the heavy fly-wheels, gives a very steady running.

The engines are provided with a separate silencer and exhaust pipe for each line of cylinders. The cooling arrangements are practically the same as with the horizontal engine. Tank water is circulated by means of a centrifugal pump; and there is also a direct connection from the town water mains. Cooling pipes are also fitted to the crank chamber. This kind of engine is specially suited for steady driving, high speed being attained without knocking, all parts being in constant thrust; this is obtained by having a high compression (about 90 lbs. per square inch) in one or other of the cylinders at every up stroke. When the bottom right cylinder is exhausting, the top right is compressing, and vice versa. The same operation occurs in the left line of cylinders, and by cushioning at the top of the pistol-valve cylinder the piston valves are also kept in constant thrust. Where economy of floor space is a consideration this kind of engine is very suitable. An engine of 150 indicated horse-power requires a floor area of 6½ feet by 5 feet, or 32½ square feet over fly-wheels, and the combined plant, engine and dynamo of 72 kilowatts, necessitates only an area of 62½ square feet.

Starting Arrangements.—The engines can be started either electrically or by compressed air. In the electrical starting the dynamo is run as a motor off the omnibus bars, pulling the engine round until it begins to explode. First the machine is plugged on to the omnibus bar, the machine automatic switch being left open. A starting resistance is then plugged into the machine circuit, the resistance switch being on the off contact. The field of the machine is next excited from the omnibus bar, by closing the shunt switch on the top or bar contact. An initial start is given to the engine by the driver, and the current is switched on gradually through the starting resistance. As soon as the dynamo is up to speed, the starting current is cut off. The voltage is then regulated by the shunt resistance, and the dynamo switched on to the circuit by closing the automatic switch. The closing of the automatic switch actuates the shunt switch, changing it over from the top to the bottom contact, and the dynamo then runs as a shunt machine. The electrical starting is worked from the switchboard by the engineer in charge.

In starting by compressed air, the engine has first to be turned by hand by the driver into the correct starting position. The stop valve admitting the compressed air is then opened, and is again closed as soon as a few explosions have taken place. The dynamo is then run up to speed and its voltage regulated; and it is put on to the circuit in the ordinary way.

Compressed-Air Starting Apparatus.—The air compressor has two water-jacketed single-acting cylinders of 4½ inch diameter and 8-inch stroke. The pistons are driven by opposite cranks. The admission and delivery of air are regulated by slide-valves moved mechanically. The crank shaft carries on one end a fly-wheel and on the other a mortice wheel, which gears with a steel pinion on the motor shaft. The power is supplied by a 6 horse-power electric motor, running at 800 revolutions per minute, and taking its current from the mains at 220 volts pressure. The air receiver is 12 feet long by 4 feet diameter, made for a working pressure of 100 lbs. per square inch, and tested up to 200 lbs.; it is provided with safety valve, pressure gauge, etc. A 4-inch air main from the receiver runs the whole length of the engine room, with a 2-inch branch pipe to each engine.

In the tandem engines the connection is made to the back end of the back cylinder. The compressed air is admitted during the impulse stroke of that end—by a valve actuated by a cam, thus giving an impulse every second revolution. The gas is cut off from the back cylinder while starting. As soon as an explosion occurs in the front cylinder, the compressed air is shut off, the starting cam put out of action, and the gas turned on, letting the back cylinder take up its part of the work.

In the single-cylinder double-acting engines the arrangement is the same, with only the difference in working that the gas is admitted to the front end of the cylinder, while starting, but not to the back end.

POWER TRANSMISSION.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST MILLENIUM EXHIBITION.—IV.

BY ALFRED O. DUBSKY

Synchronous Series Motors.—These motors are of the same construction as the series direct current motors; they have stationary field winding and a revolving drum armature. They start under full load, the number of revolutions diminishing with the increase of the load. The commutator brushes are made of carbon and no sparking is visible at normal load. Fan motors of the same type are manufactured. A noticeable quality of these motors is that their current can be reversed without the use of any rheostat. The flow of current is greater on reversing, of course, but it does no harm to the motor, which changes almost immediately the direction of its running.

In the foregoing description I have mentioned the alternating current single-phase machinery at the exhibition at Budapest. I will now give a further description of the polyphase plant, which contains some very interesting and very little known apparatus.

Three-phase Machinery.—There are two three-phase generators exhibited, each of 200 horse-power capacity, at 250 revolutions per minute. The distribution of the three-phase current is made at the pressure of 300 volts between two conductors,

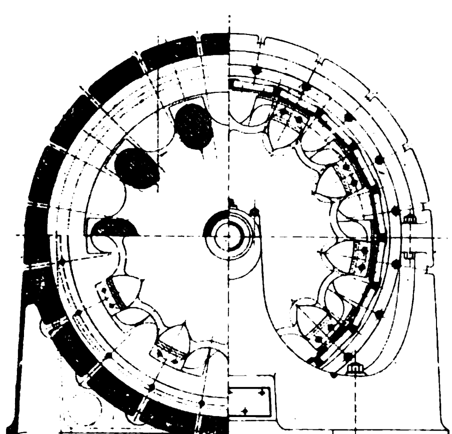


FIG. 18.

and the motors are wound directly for this voltage. One of these dynamos works at this same pressure, so its current can be used, therefore, directly for power distribution. The other generator is wound to give 3,000 volts, and several step-down transformers provide the low tension network with current. The number of periods is always 42 per second. As even the smallest motors never have less than 4 poles, the highest number of revolutions at the motor shaft is only about 1,200 per minute.

Figs. 18 and 19 give two vertical sections through this generator. There are no revolving conductors, as the revolving part consists of a star wheel made of cast steel, with projecting poles composed of laminated iron, shown in Fig. 20. There are ten such poles on each side of the machine. In this way the generator has two distinct armatures, each provided with an independent winding. The exciting coil is coaxial with the generator shaft, and by sending a continuous current through this coil a magnetic flux will pass through the winding of both armatures, according to the momentary positions of the projecting poles of the revolving part. These projections have a relative displacement on the two sides of the generator, and this displacement is equal to half the width of two projections. It will be quite apparent that the induced e. m. f.'s in the two distinct armature windings will have a relative difference of phase of exactly 90 degrees. By using now the well-known arrangement proposed by Mr. C. F. Scott, it is quite easy to obtain three equal electromotive forces with a phase difference of 120 degrees. For this purpose one armature is wound directly for a tension of 300 volts between its two terminals. The other armature has a number of turns 0.867 times less than the former armature, and as the sections of iron are exactly equal in both armatures, there will be an equal magnetic flux passing through the bobbins of both windings, the tensions will be therefore, in the ratio of the number of turns. We now connect the terminal of one armature (with the smaller number of turns) to the middle of the winding of the other one and the three remaining terminals will allow the commutation of three-phase currents.

There are great advantages to be obtained by using this ar-

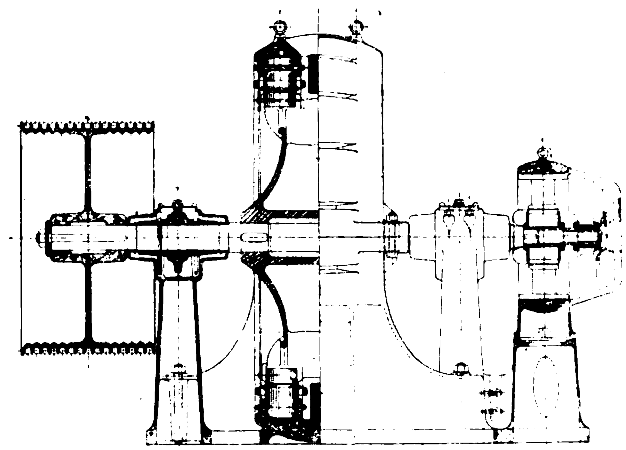


FIG. 19.

rangement. If there should be three distinct series of coils to generate the three-phase current the machine would be far more complicated and expensive. In this way the costs of punching and the number of coils are less, for the number of poles is only twice as large as the number of the pole projections. Moreover, the crossing of the connections is completely avoided, which is a great advantage for high-tension work. Most of the three-phase generators manufactured by the different firms have just this latter fault. In the present construction the bobbins are wound quite separately and are slid on the several armature poles. They are held in their places by the use of wooden wedges; the insulation of the iron parts of the machine is made of thick sheets of micanite.

The further construction of this generator is clearly demonstrated in Figs. 18 and 19. The continuous current exciter is connected directly on the generator shaft in such a way that the complete armature is built on a sleeve, which latter is keyed on the shaft without the use of any external bearing. The complete machine with its exciter, as shown in the exhibition, is illustrated in Fig. 21. This machine is driven by ropes from its steam engine, the other mentioned three-phase generator of the same size is coupled directly to its steam engine.

All these machines work with a magnetic flux more consider-

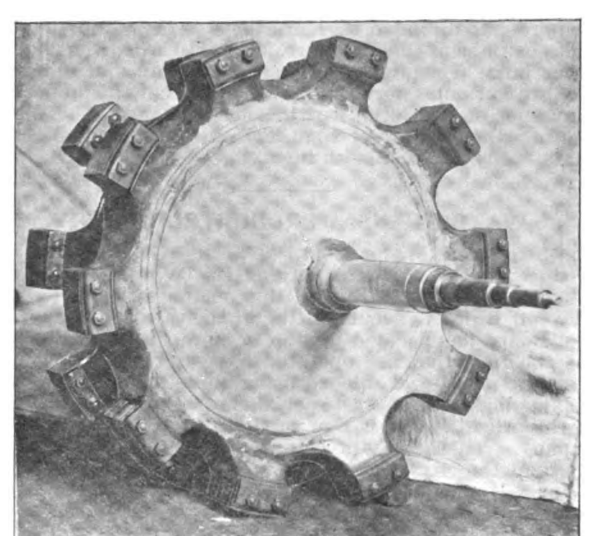


FIG. 20.

able than the special lighting generators. Without changing anything in the exciting current the drop of voltage between no load and full load on motor circuits never exceeds 15 or 20 per cent.[1] These machines are constructed for the use of mo-

[1]The short-circuit current is about 4.5 to 5 times larger than the current at full load.

tor circuits; for lighting purposes it is always more advantageous—for reasons of security—to employ dynamos having more copper and less iron in the armature.

The special construction of these generators renders it possible to obtain also single-phase currents from them. One armature always generates single-phase currents, for it is only by the combination of both armatures that three-phase currents are produced. One 200 horse-power, three-phase dynamo at the exhibition has been charged with 90 kilowatts in one armature and is still employed at times to supply single-phase lighting current. Moreover, single-phase and three-phase currents can be produced at the same time by these dynamos. It would be then a true "monocyclic" installation, with the difference, that one entire armature is employed distinctly for the services of the "teaser coil."

The current produced by these generators drives the different

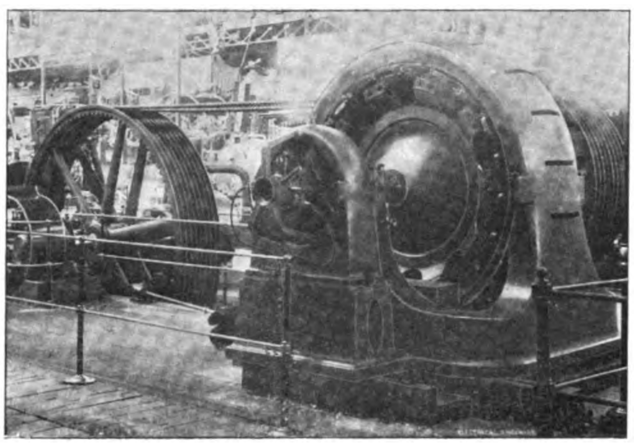


FIG. 21.

three-phase motors, distributed over one part of the exhibition. They are used for driving various machine tools, such as printing machines, looms, pumps, etc.

All these motors are of very different sizes. The smaller motors up to 8 horse-power have a rotor with a short-circuited armature and are switched directly on the circuit. The starting current under full load is about three times the current used when remaining at full load, and the starting torque is somewhat larger than the torque at normal running. The larger motors, those above 8 horse-power, are of a different construction. In order to diminish the starting current and increase the starting torque, the inductors revolve and the induced armature is stationary, the latter having a diphase winding in order to diminish the variations of the torque in the different positions of the armature. A fluid rheostat is used to introduce large resistances during the starting and these resistances are cut out afterwards from the circuit in proportion as the number of revolutions of the motor increases. These motors are suited to direct high-tension work, and an efficient plant is easily obtained with them.

WATER FANS A PROHIBITED LUXURY.

The Street and Water Board of Jersey City has determined to reduce the cost of maintaining the Water Department to the lowest possible figure, and thus enable the city to pay the heavy bill which is accumulating at the rate of $1,000 a day.

The Board has decided to stop in stores, restaurants and saloons the fans that are operated by water motors. There are 110 stores, shops and saloons using these fans, and water has been supplied to them at a special rate, which is less than one-half the price the city is now paying to the East Jersey Water Company. These motors consume a large volume of water daily, and the city is losing a considerable sum by continuing the special contracts, which were made when the city was pumping its own water. There is now a good chance to sell some electric fans in the city.

BUFFALO, N. Y.—Mr. H. H. Pratt, electrical engineer and contractor, Builders' Exchange, Buffalo, writes us: "I am a regular reader of your paper, and in each issue find much useful information for one in my business. I thank you for giving the trade so valuable a publication." Mr. Pratt has just bought the material for a municipal plant at Mayville, N. Y., but is in the market for quotations on other construction materials for work in view.

ROENTGEN RAYS.

CHARACTER OF ROENTGEN RAYS.

The Rede lecture at the University of Cambridge was given by Prof. J. J. Thomson, who took as his subject the Röntgen rays. After describing the properties of these rays as far as they have been discovered by experimenters, he stated that to sum up we may say that though there is no direct evidence that the Röntgen rays are a kind of light, there is no known property of these rays which is not possessed by one or other of the forms of light.

One of the most remarkable phenomena connected with these rays is the way in which the absorption depends upon the density of the body; if we measure the transparency of a series of bodies, we find that the order of opacity is the same as the order of their density. No other factor in the constitution of the body seems comparable in importance with density. In this respect, the relation between the opacity and the other properties of a body in the case of the Röntgen rays is simpler than that for luminous waves or electric waves. There seems no simple relation between the density of a body and its transparency to visible radiation or electrical vibration; in the case of the Röntgen rays, however, it seems the greater the density the greater the opacity. This appears to favor Prout's idea that the different elements are compounds of some primordial element, and that the density of a substance is proportional to the number of the promordial atoms; for if each of these primordial atoms did its share in stopping the Röntgen rays, we should have that intimate connection between density and opacity which is so marked a feature for these rays.

There seems considerable evidence that the energy associated with these waves is small. I am not acquainted with any effects produced by them which involve the expenditure of an amount of energy comparable with that emitted in a second by a candle. They do not produce any appreciable rise in temperature when they fall on the thin metallic strips of a bolometer. Mr. Skinner has found that they exert no appreciable effect on the combination of hydrogen and chlorine, though this is a good test of the intensity of very faint light; and, what is more unfortunate, they do not exert any of those deleterious effects on bacteria which are fortunately associated with ultra-violet light. Some of the other effects exerted by ultra-violet light seem to be associated with these rays; thus some observers who have had undue curiosity about their bones, and have in consequence exposed their hands frequently to these rays, have found that the hand so exposed became sunburnt. There seems considerable evidence, too, that these rays are not good for the eyes, though it is difficult to disentangle and distinctly injurious effect due to the rays from the bad effect that may be produced by the straining of the eye in the endeavor to see only a faintly luminous object.

There is one property of substances which seems peculiarly suitable for testing if these rays affect the substance through which they pass: it is the property of transmitting electricity. When we investigate the effect of the Röntgen rays on this property, we find the remarkable result that bodies which, when shielded from these rays, insulate to all appearances, perfectly allow electricity to pass through them when exposed to the action of these rays.

Experiments were then shown to prove that a gas, which is ordinarily the most perfect insulator of electricity known, will permit considerable leakage of current when acted upon by these rays. Ebonite, paraffin and other solid insulators were also shown to be conductors under the action of the X-rays.

EXPERIMENTS WITH X-RAYS UPON GERMS.

Some experiments have been made by Dr. William Shrader, of the Missouri State University, to test the effect of the Röntgen rays upon various disease germs. In nearly every instance these are reported to have met with success and prove conclusively that the rays are invaluable in the treatment of these diseases. Among the first experiments were those made with the diphtheria bacilli; tubes were inoculated with the germs, one exposed to the rays and the other not exposed. In the former the germs were destroyed, while in the latter they lived.

Following these tests two guinea pigs were inoculated with a solid culture of diphtheria, prepared in the bacteriological laboratory of the university. These pigs weighed 210 and 185 grams respectively. One was exposed to the rays for four hours in a wooden box, having a rubber cover, and is alive today after eight weeks, and no trace of the disease can be found. The other pig, not exposed to the rays, died within 28

hours after the injection of the poison. The post-mortem examination showed that his death was due to the diphtheria germs.

X-RAY INVESTIGATIONS.

It is stated by the London "Electrical Engineer" that Messrs. Novak and Sulc have examined nearly 300 substances with a view to ascertain the absorption of the Röntgen rays by chemical compounds. Their method of investigation consisted in attaching rings of glass to a sheet of paper and placing uniform layers of the finely-pulverized materials in the different rings so that the thickness of the layer was 0.4 cm. in each case. The paper with the rings was then placed over a photographic p'ate, which was enveloped in black paper and exposed to the Röntgen rays for a period of 20 to 25 minutes. By comparing the photographic effect of the rays where the substances were interposed, the relative absorptions were determined. A great number of organic compounds containing only carbon, hydrogen, oxygen and nitrogen appear equally penetrable, and hence it is concluded that the absorption has no relation to molecular weight or the arrangement of the atoms. Organic halogen derivatives have been found to possess much greater absorption, which increased with the number of halogen atoms present. This effect increased with the atomic weights of the halogens, two atoms of bromine having a greater effect than six chlorine atoms, while iodine derivatives were entirely impenetrable under the condtions used in the experiments. It may be added that Mr. Edison has already made a similar series of investigations.

DISCHARGE OF AN ELECTRIFIED BODY BY MEANS OF THE TESLA SPARK.

In a communication to "Nature" Mr. Frederic J. Smith states that it has been shown that a body charged with electricity may be discharged by means of the rays from a Röntgen bulb. "I find, also, that an electrified body is rapidly discharged by the influence of a high-frequency spark, such as that produced by the Tesla apparatus. The discharging action was shown in this way. A high-frequency spark was produced between two rather blunt points, one inch apart in air, no bulb being used. A gold-leaf electroscope, placed far away from the influence of the spark, was used to test the electrical condition of the charged bodies—viz., a stick of sealing-wax and a rod of glass. The sealing-wax was rubbed, and the electroscope indicated that it was well charged. It was again rubbed, and then brought to within a foot of the points, and by means of a key in the battery circuit the Tesla coil was thrown into action for an instant. On testing the sealing-wax rod with the electroscope, it was found to be entirely discharged. A similar experiment was next made with a glass rod; the glass rod was entirely discharged by the Tesla spark. From a previous experiment, it was seen that the electrification of the rods was dissimilar. The influence, then, of the high-frequency spark is to discharge electricity of either sign."

ELECTRIC TRANSPORTATION.

TO PROPEL BOATS ON THE WACO LAKE BY THE TROLLEY SYSTEM.

Among the enterprises suggested by the new Brazos River dam the citizens of Waco, Tex., will build is one which two Ohio men say they will put into execution if they can get a franchise giving them the exclusive right of moving boats on the lake by electricity. Their plan is to put a turbine wheel in, below the dam, and convert the water power into electricity. They will propel their boats on the trolley system and will carry passengers at a high rate of speed along the shores both on the Brazos and the Bosque.

A railway, based on the Greathead system of tunnels, is now proposed for Brussels. It is to be worked by electricity and to run 50 feet below the surface. The first portion is to consist of a complete circle about four miles long, with double track, having 11 stations, and a future extension of a second circle of about two miles long, with four stations. The two tunnels for the different directions will be quite distinct from each other, and run almost entirely below the public streets. There is to be a two and a half minute service each way. The total cost of the first circle is estimated at $3,000,000, a less rate than the City and South London Line, which cost $1,000,000 per mile. The elevators are to be operated by hydraulic power and will hold 40 people. Why electric elevators are not used is a mystery.

THE UNDERGROUND ELECTRIC ROAD IN BUDAPEST.

THE city of Budapest now possesses an underground electric railway in addition to its 28 miles of electric conduit railway. The new underground road was installed with the object of providing a direct route from the center of the city to the park, in which the Millenium-Hungarian National Fair is being held, which is a distance of about two miles. A franchise for a surface road through Andrassy avenue, which is about 125 feet in width and is used as a speedway, has been several times denied by the authorities, so the idea of a tunnel was advanced. Careful estimates by government engineers

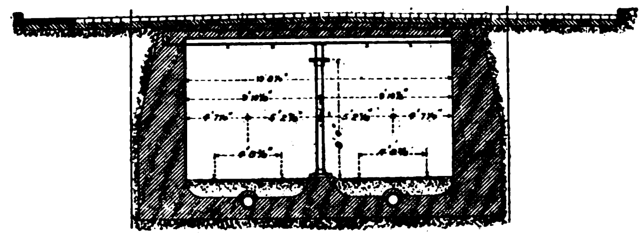


FIG. 1.

placed the cost at $656,000 per mile of double-track road complete, ready for operation. Assuming cars on five minutes' intervals from 6 a. m. to 11 p. m., 204 cars starting each way, the cars having a capacity of 50 passengers, 20,400 passengers can be carried per day. The schedule time from end to end is 18 minutes, corresponding to a speed of 12.5 miles per hour.

Ground was broken on August 13, 1894, the tunnel completed in December, 1895, and the railroad opened for traffic on May 2, 1896, the opening day of the fair. The work was done within the estimate. Nearly 25,000 passengers daily were carried during the first three days of operation.

The exact length of the tunnel is 10,467 feet. It connects with

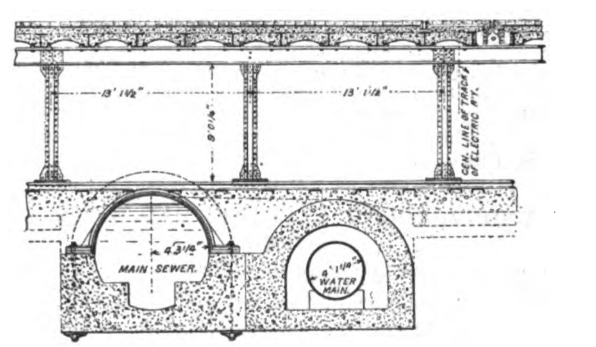


FIG. 2.

1,640 feet of surface lines in the park proper, making the total length, therefore, 12,107 feet and there are 11 stations. Nearly all of the earth was removed from the surface without tunneling. In the first three of the accompanying illustrations, taken from the "Railroad Gazette," Fig. 1 shows a cross section of the tunnel and Fig. 2 a longitudinal section. The steepest grade is 2 per cent; it occurs at the spot shown in Fig. 2, where the tunnel crosses over the main sewer and under the tracks of the surface electric conduit railroad. The shortest radius of curves is 131.25 feet. The bottom and the side walls of the tunnel are

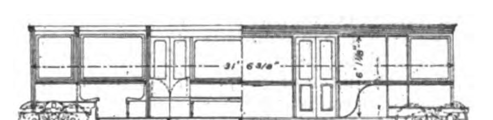


FIG. 4.

built of concrete, the latter were constructed first. The ceiling consists of concrete arches between I beams. These beams rest in the center of the tunnel on a stringer, which in turn is supported by columns, 13 feet 1½ inches center to center. The I beams were placed first, after that the stringer and the columns. The tunnel measures 9 feet 0.¼ inch from the top of the rails to the bottom of the beams, and is 19 feet 8¼ inches wide.

Fig. 3 represents the car, and Fig. 4 shows in detail the manner in which the tracks are attached to the car bodies. The body

is suspended between the trucks, and the bottom of the car is brought within 15¾ inches of the top of rails. The clearance between the car and tunnel wall is 7⅞ inches. The outside dimensions of the car body are: 31 feet 6⅜ inches long by 7 feet 6¾ inches wide by 7 feet 1⅛ inches high. There are two doors on either side of the car, 14¾ inches wide in the clear; those on the side of the columns remain closed, and seats, folding back sideways, are provided to utilize the space. The doors cannot

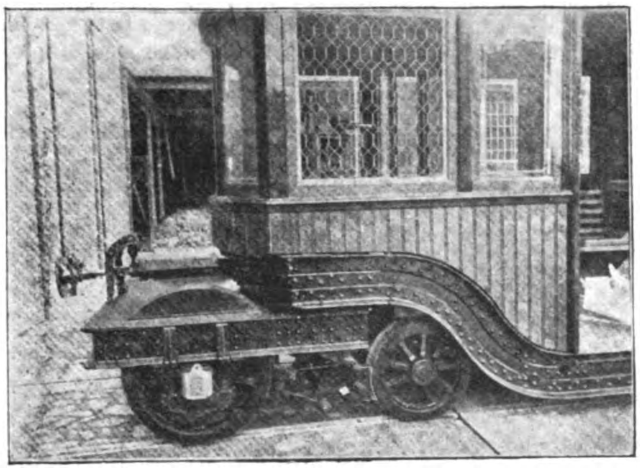


FIG. 3.

be opened until the current is turned off, nor can the current be turned on until the doors are closed. The cars seat 30 persons. The partitions shown in the drawing have been taken out, but the space over the trucks is partitioned off from the rest of car body for the motorman.

The current is fed in and returned through overhead wires; the rails are not in the circuit. Two 300-volt 100 horse-power generators for the tunnel were added to the existing power station.

The station platforms are from 10 to 16 feet wide and from 66 to 98 feet long. The station walls are covered with white glazed tiles. All iron parts throughout the tunnel are painted a silver color, which reflects the electric light and makes the tunnel as light as day.

NEW UNDERGROUND ELECTRIC RAILWAYS IN LONDON.

GREAT activity is being shown in London at present in planning underground street railways, and all of the roads under consideration are to be equipped with electricity by reason of the conspicuous success of the electric road already in operation.

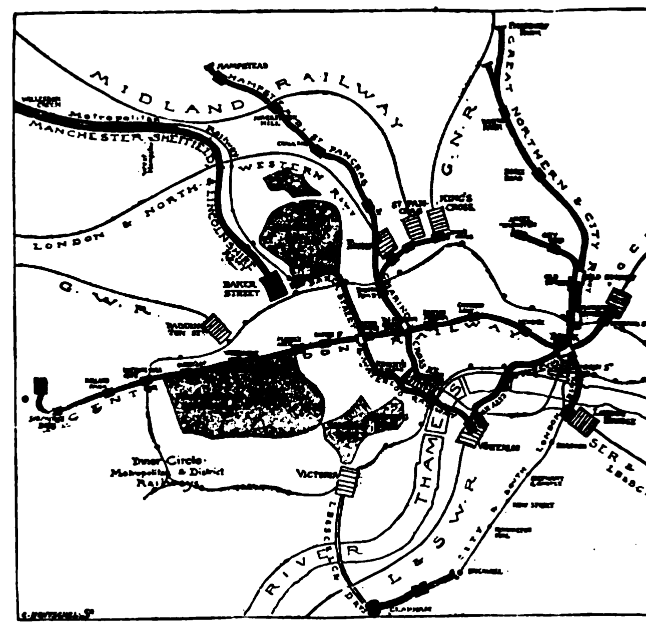
The railway referred to is the City and South London, opened in 1890. Here for the first time was tried that invention of Mr. Greathead's which, equally with electric traction, has helped to revolutionize urban railway construction. This contrivance, familiarly known to engineers as the "Greathead shield," is an air-lock system of tunnelling which enables work to be executed expeditiously at any depth, in perfect safety; and to be continued unhindered quite irrespective of whatever springs may be encountered while boring. The railways now under construction will be tunnelled in this manner at an average depth of sixty feet beneath the pavements of London, and no sign of their progress will be visible to those who use the streets, excepting only on the sites of proposed stations, where shops and houses are being demolished.

The accompanying map will serve to show the relations existing between the great trunk lines, with their outlying termini, and the Metropolitan and District Railways. To these are added the various electric railways authorized from 1891 to 1893, and the new trunk line, the Manchester, Sheffield, and Lincolnshire Railway is indicated.

There are no fewer than six lines authorized, two being at the present moment actively pushed forward. The Waterloo and City Railway is the shortest of all, and has but two stations, one at Waterloo and the other at the Mansion House. This particular line is, perhaps, the most urgently needed of all, and it is now rapidly approaching completion.

But public attention is attracted just now principally to the Central London Railway, which will run from Shepherd's Bush to Liverpool street, a distance of six and a half miles. Authorized in the sessions of 1891 and 1893, its construction has just been undertaken by the Electric Traction Company, who have let all the contracts and have already commenced pulling down the houses that occupy the sites of the fourteen stations along the route. Trains stopping at each station will be run at intervals of two minutes and a half, and will perform the journey from end to end, including all stoppages, in thirty-five minutes. The cost of construction and equipment, calculated at £500,000 per mile, brings the total cost to £3,500,000.

The rail level will not be less than 85 feet beneath the surface at some points on this line, and five hydraulic lifts will convey passengers to and from the trains, and subways will be con-



RAILWAYS IN LONDON.—NEW RAILWAYS SHOWN BY HEAVY LINES.

structed for foot passengers to cross from one side of the road to the other. The company expects to carry between fifty and sixty millions of passengers in the year, but the actual capacity of the line is 85,000,000. The boring of the two tunnels, which will be circular, lined with iron, and but 11 feet 6 inches diameter, will be proceeded with from each station simultaneously. By December, 1897, this work will have been completed.

It will serve to give some idea of the magnitude of these combined railway enterprises when it is considered that the number of new stations they will involve will reach a total of forty-five.

THE MEANING OF GRASS IN THE STREETS.

It used to be regarded as extremely discreditable to a city to have it truthfully said that grass grew in the middle of its streets, and the person who made the remark was regarded as an enemy from a rival town. The remark has lost its sting now, and people point with pride at the blades of grass struggling in the chinks between the paving blocks. It is an evidence of progress, and proof that the people of the place are hustlers. Conditions have changed in the last six or seven years in nearly every city in the country. Grass could not have grown in the middle of the busiest thoroughfares then, while now the busier the thoroughfare the more chance it has to grow.

The electric railroad lines have brought this about, says the New York "Sun." Where they run most frequently they have the tracks and the spaces between the rails and between the tracks almost entirely to themselves. Drivers of vehicles do not care to be constantly turning out for trolley cars, and consequently they keep out of the middle of the streets and off the car tracks. In the horse car days the grass was kept down by the iron-shod hoofs, not only of the car horses, but of those attached to all kinds of vehicles whose drivers found it convenient for themselves and easy for their animals to make use of the smooth rails.

Then the grass did not grow in between the tracks to any extent. Since the advent of the trolley there has been a strong tendency in some towns to encourage the growth of grass upon the part of the road occupied by the tracks, and trolley lines

have been laid out upon many new roads in the outskirts of various cities with the view of having an eye-resting and pleasing strip of greensward the whole length of the line. The roads have electric sprinklers and sweepers, and perhaps the next interesting feature of trolley progress will be a track mower run by a motor to keep the grass down to the condition admired in private lawns and public parks. Then, as a natural consequence, there may be a trolley rake to follow.

TROLLEY FROM NEW YORK TO PHILADELPHIA.

Mr. Frank A. Magowan and J. Henry Darrah, of Trenton, N. J., after nearly a year's hard work, have formed a syndicate of New York and Philadelphia capitalists to construct an electric railway between New York and Philadelphia, the distance being nearly 100 miles as the road runs. The New York and Philadelphia Traction Company has been formed, and associated with it is the Central Jersey Traction Company.

At the head of the enterprise is Mr. J. Canby, of Philadelphia, who has had much experience in traction railways. The syndicate for the traction road through New Jersey is not only formed, but stock has been transferred and a partial payment made to the promoters, Messrs. Magowan and Darrah, and John Blair McAfee, of Philadelphia.

Work upon the new road is to be commenced in a few days. A contract has just been given out for operations between New Brunswick and Bound Brook and Raritan and Dunellen which will amount to $475,000. A power house to cost $100,000 is to be erected near Bound Brook.

The New York and Philadelphia Traction Company was incorporated on July 13, 1894, with a capital stock of $10,000,000, by Frank A. McGowan, who took in the Central New Jersey Traction Company. There will be one thousand miles of road, connecting nearly all the large towns of New Jersey.

The direct line of the main stem will begin at Paterson, where connection will be made with the present system. Then the road will pass through Upper Montclair, Montclair, Bloomfield, Orange, East, West and South Orange, Maplewood, Wyoming, Springfield, Westfield, Fanwood and Northwood, to a connection with the present system in Plainfield, and thence through Plainfield to Bound Brook.

Crossing the New Jersey Central Railway at Finderne, the road will continue through Hillsboro and Weston, and thence to Millston, Rocky Hill, Princeton, Lawrenceville and Trenton.

Branches will run from Bound Brook to New Brunswick, Somerville and Raritan; from Bloomfield to Irvington, and to Morristown, via Chatham and Madison. At Irvington connections will be made with the existing lines, making a direct route to Newark and Jersey City.

From Westfield the road will run to Rahway, connecting there with the line to Lebanon and Boynton, South Beach, Woodbridge and Perth Amboy. From Rahway the line will go to Elizabeth, and a branch will connect Bound Brook with New Brunswick.

From Trenton, the road will pass through Morrisville, Bristol, Cornwells, Terresdale, Tacony, Holmesburg, and Frankfort, and thence into Philadelphia.

AN INGLORIOUS CHAPTER OF TROLLEY ACCIDENTS.

THE newspapers within the past two weeks have recorded a number of serious trolley accidents, most, if not all, of which appear to be preventible. While the heavy summer pleasure travel, and the strain on the men, due to the intense hot weather, may excuse these things in some degree, they should not happen. We present a few typical and local cases, from which lessons may well be drawn.

A dispatch from Lancaster, Pa., of August 10, says: The disaster on the Columbia and Donegal Electric Railway, north of Columbia, at 10:20 o'clock last night, is the worst that has occurred in this county in many years. Up to the present time six persons are dead and sixty-two injured, some of them seriously, and several are expected to die. The accident occurred at a heavy curve just north of the borough limits of Columbia. The exact cause probably will never be known, the motorman being dead, and the statements of passengers widely differ. A large crowd gathered at Chickies Park last evening to enjoy a sacred concert and escape the heat. The ill-fated car—a closed one—was the first to leave the park after the concert, and was packed in every part, both platforms and aisle being crowded. The trip was without incident until the heavy grade just north of Columbia was reached. The car here attained a great velocity, which the motorman was unable to check. The brake refused to work and the supposition is that the brake rigging broke. Passengers were thrown from their seats, and as the lights went out they were thrown into a panic. Several jumped from the flying car, and others tried to do so, as the last curve was reached. Here the car left the track, shot across the turnpike a distance of nearly 100 yards, crashed into a train, and then tumbled into a ditch twenty feet deep. The car was turned upside down, and, as the night was intensely dark, the situation, with the cries of the dying and injured was a frightful one. The passengers who escaped severe injury aided the less fortunate ones, and assistance was soon procured from Columbia, the injured being removed to the hospital in the town, where they received every attention.

On August 8 a collision between a railroad train and a trolley car, by which three persons were seriously injured, the trolley wrecked, and the locomotive disabled, occurred at Homestead Station, North Bergen, N. J. Trolley car No. 102, crowded with passengers, left the Jersey City, Hoboken and Rutherford station, in Hoboken, at 7:30 o'clock. It reached the New York, Susquehanna and Western Railroad crossing at Homestead at 8:02 o'clock. A westbound train from Jersey City was then due. Just as the trolley car reached the crossing the trolley pole slipped from the line wire, and the car was brought to a full stop directly on the crossing. At the same time the lights went out, leaving the car in darkness. At that moment the New York, Susquehanna and Western train came in sight. Its engineer was slowing down, or the consequences might have been more disastrous. The car conductor and the motorman, seeing that a collision was inevitable, shouted to the passengers on the trolley to jump off. All obeyed the order but two persons. They were a man, seventy-two years old, and his wife, sixty years old. They were unable to get out of the car, both being infirm. The engine struck the trolley car, knocking it from the track and leaving it a hopeless wreck. When the old people were extricated from the débris they were found to be seriously injured. When the engine struck the car its engineer was thrown out of the cab and badly injured. He was put on a train going east and taken to Jersey City, where he was sent to the City Hospital.

The cowcatcher and pilot of the engine were smashed and the train was delayed until another engine could be sent from Jersey City to take it to its destination.

On August 8, car No. 106 of the Staten Island Electric Railroad at 2 o'clock p. m. ran into the platform of the waiting room at Port Richmond. The motorman says the accident was caused by the failure of the brakes to work. He says they were all right when he was about a mile from the ferry landing, but when he tried to put on the brakes a short distance from the waiting room they would not work, and the accident could not be avoided. The speed of the car drove it partly through the waiting room, and caused much excitement. Several women and children who were in the waiting room at the time had a narrow escape. Two women, who refused to give their names, were cut about the face by flying glass.

On August 9 trolley car No. 131 of the Nassau line jumped the track at Fifth avenue and Thirty-ninth street, Brooklyn, early in the morning and ran into the gutter. A passenger was thrown out of the car. His left leg was fractured and he was taken to the Norwegian Hospital. Several other passengers were injured, but they refused to give their names to the police, and were taken home for medical treatment.

AMERICAN APPARATUS FOR EUROPE.

Besides selling a fine mechanical and electrical equipment to the Krupp Works, in Germany, the Brown Hoisting and Conveying Machine Company, of Cleveland, have now received an order for three of their largest overhead bridge tramways for the handling of coal and ore, for the Krainische Industrie Gesellschaft, a large Austrian manufacturing concern. These orders have both come entirely through correspondence. The Brown Works have had many inquiries in the past from abroad, but have only of late begun to pay systematic attention to them, with a view to securing the business.

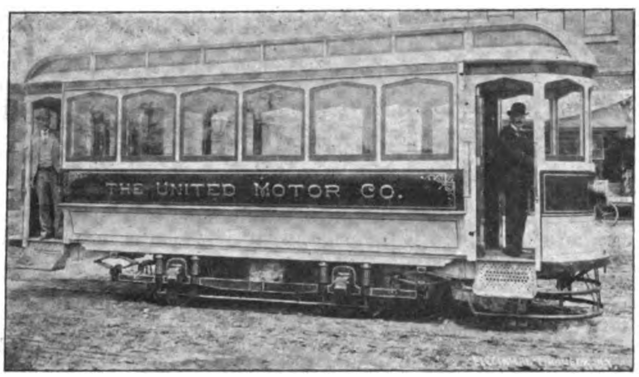
NEW HAVEN, CONN.—It is proposed to handle freight in the Elm City by trolley, and for that purpose the Manufacturers' Street Railway Company, of New Haven, Conn., has purchased the electric locomotive exhibited by the General Electric Company at the Chicago Exposition in 1893. This locomotive has a rated drawbar pull of 7,000 lbs., the weight is 30 tons. It will be used to haul freight cars nearly two miles of the road along the water front. The maximum grade is 2½ per cent., and the guaranteed speed of the locomotive on this grade with a heavy load behind it is seven miles per hour.

TROLLEY VALUES AT LEOMINSTER, MASS.—It is said that Leominster has increased $1,000,000 in valuation in the past year through the electric lines within its limits. And they talked of revoking one of the franchises!

THE WASHBURN SELF-CONTAINED MOTOR CAR.

BY J. S. C.

IN the recent "Fiftieth Anniversary" number of the "Scientific American," the editorial on "The Effect of Inventions on the People's Life" touches upon the early steam engine and its improvements, modern machine tool developments, the telephone, the telegraph, and the supplanting of the now antiquated horse car service by the modern trolley road, and, in emphasis of the tremendous influences of this system of intercommunication upon existing sociological questions, it says, after referring to other factors along these lines, that "The self-contained motor car which can work independently of any central station is still in embryo. Many are in use, especially in Paris, but they are few in number compared to the central sta-



THE "PIONEER" SELF-CONTAINED STREET CAR.

tion car lines. A car motor needs such an exceptional reserve of power that the problem of devising an adequate motor for it is far from easy. The storage battery, for which boundless fields of utility are open as soon as it shall become lighter and more practical, has been tried on street cars and operates a number to-day. The explosion oil engine may yet solve the problem. Hitherto the weight of the motor mechanism and the difficulty of establishing a sufficient reserve of power are the difficulties to be overcome."

The foregoing prophetically calls attention to the needs and the possibilities of more economical and independent means for urban and interurban transportation. Such a system has been designed and the car for practical demonstration has been constructed; a number of successful trial trips have been made which its projectors claim prove conclusively that the system is all they have hoped for.

All independent unit systems, wherein each car is separate and free to go and come independent of every other car, have so far been obliged to equip the car with power apparatus of sufficient initial capacity to meet the maximum demands at any point of the line. All this in the face of an undeniable fact that but 75 per cent. of this amount of power is all that is required for the greatest part of a run. In other words from 50 to 75 horse-power must be provided, the weight of which must be carried continuously, for a five or ten minute use during a trip when 8 to 12 horse-power is all that is required for the remaining fifty minutes of the trip, thus showing a most inefficient combination of elements.

This new system, devised by Mr. Geo. A. Washburn, of Cleveland, O., consists of a suitable car body and trucks, a prime mover in the shape of an explosive engine, a dynamo motor combined in one machine, and a light storage battery.

The car is provided with electric lamps throughout and it is capable of traversing any of the city tracks, whether trolley wires are provided or not. The car could be placed upon the L. S. & M. S. tracks and a journey to New York City undertaken without making any other preparation than the procuring of a few gallons of liquid fuel.

This car it is thought will introduce a new element into the rapid transit problems in that present steam railroads may enter into active competition with existing local lines, for the reason that a single car can be purchased for about the same cost as a large trolley car and as soon as this purchase is made the company is at once ready to commence operations, without the necessity of building a large power station, stringing overhead wires and erecting the poles to support them, with the attendant cost and loss of time in getting under way for active operations.

This car is a near approach to an automatic equipment. Before starting the car on its first trip out from the factory, the engine is set in operation and, being disconnected from the car axles, it rotates the shunt-wound dynamo motor and charges the storage cells. As soon as these are charged the car can be set in motion for actual service. The engine is of about one-third the maximum capacity required, and as the car is started from a standstill more power is required than it possesses. Here then the most beautiful and flexible part of this system shows itself, because the storage battery, automatically, turns in and helps out the engine, and as soon as the car is under way, the demands for power drop below the capacity of the engine, and the power not required for propelling the car is automatically, as before stored in the cells for future use. When the car slackens up for a stop the engine continues at its highest efficiency, under full load, to the standstill of the car, and upon again starting, the storage cells again automatically "help out." From this it will be seen that the car is an independent unit, not hampered by trolley wires and power stations.

Should unforeseen accidents happen, enough power would be available, either in the battery or engine, to reach the nearest station at reduced speeds, so that a car would not become "dead."

New cross-country lines can be started with this system at a cost of but a fraction of the amount necessary to equip the present trolley roads, hence making it possible to extend electric railways into sections which capital will not now touch.

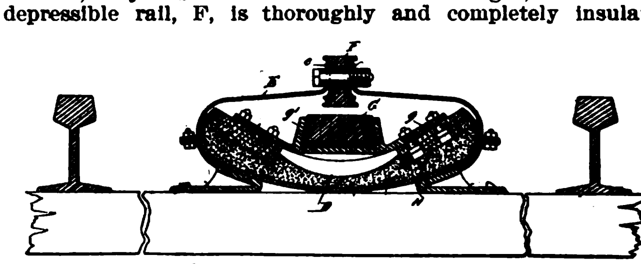
This car is owned by the United Motor Company, of Cleveland, O. The president of the company is Mr. J. J. Shipperd, who is prominently connected in many street railway enterprises.

GRUNOW'S CONDUIT RAILWAY SYSTEM.

A NEW electric conduit railway system invented by Mr. William Grunow, of Bridgeport, Conn., is shown in the following illustration. The conduit, which is shown in cross section, consists of a continuous trough which sets between the tracks and upon the cross-ties, and is filled in throughout its length with asphaltum or any material which is a nonconductor of electricity and which will also not absorb moisture. The asphalt is arranged so as to form a gutter, D, in the central part of the conduit, the sides being inclined.

To the opposite sides or edges of the trough are bolted longitudinal flexible elastic spring-plates, E, which are curved or shaped in cross-section, as shown, and which are upturned at their inner edges, as shown at e. These support between their upturned edges a depressible rail, F, which is thoroughly insulated from the metal plates, and from the bolts passing through them, which hold them rigidly together.

It will thus be seen that there is provided a tubular or hollow conduit, all joints of which are made water-tight, and that the depressible rail, F, is thoroughly and completely insulated



GRUNOW'S ELECTRIC CONDUIT.

throughout its length. Inclosed in this conduit and lying about midway, free and clear of the inner walls of the conduit, is a conductor, which is preferably of a size large enough to carry the full current without the use of feeders. This conductor is supported at intervals by cross bars or supports, g, provided with flanges, g, and from these cross bars or supports the conductor is fully insulated. These cross bars rest upon and are bolted to insulating blocks, H, which may be formed of glass, hard rubber, porcelain, or similar material, and which are embedded in the asphaltum. It will thus be seen that the conductor is free and surrounded by air, one of the best known conductors, and that it is fully insulated from its immediate supports and also from the conduit walls.

The depressible rail, F, is formed in sections whose ends are insulated from each other, but which are mechanically connected so as to form one rigid rail throughout its length. The object of forming the rail, F, in the sections described is to provide means whereby only one or two sections at a time may be charged with the electric current and the section or sections so charged will be those directly under the car.

In operation, the device by which contact is made with the rail, F, is secured to the bottom of a car in such manner as to bear upon the rail, F, with a force sufficient to depress it in contact with the conductor. The amount of this pressure is immaterial, and may be made to suit the requirements of the case or the situation of the line.

TELEPHONY AND TELEGRAPHY.

BELL TELEPHONE FIGURES.

The instrument statement of the Bell Telephone Company for the month ending July 20 shows a sharp falling off in the number put out from previous months, and also from last year. The instrument exhibit follows:

Month July 20.	1896.	1895.	1894.
Shipments	12,584	13,837	6,430
Returned	10,490	7,513	5,754
Net output	2,094	6,324	676
Since Dec. 20.	1895-96.	1894-95	1893-94.
Shipments	126,678	98,896	47,455
Returned	53,667	47,121	40,449
Net output	73,011	51,775	7,006
Total outstanding	749,547	634,281	573,497

THE PACIFIC CABLE.

In the discussion of the Colonial votes in the House of Commons on August 11, Sir Charles Dilke, Advanced Radical, said he hoped Great Britain would not be persuaded to grant a subsidy for a Pacific cable. The first cable, he added, should be from Gibraltar to Cape Town and Australia, which was of the utmost importance.

The Secretary of State for the Colonies, Mr. Chamberlain, said that the Government had not yet pledged itself to grant a subsidy for the laying of a Pacific cable, but the Government was pledged to make an inquiry into the advantages of that route for a cable and regarding the proportionate distribution of the cost. Strategically, he added, the laying of a Pacific cable was of great importance, and, moreover, he continued, it would have great support from Canada and Australia.

THE NEW FRENCH CABLE.

The Paris "Temps" states that the manufacture of the submarine cable which is to be laid between Brest and New York has already been commenced and will be completed by next summer. The new line will be open either in the month of August or September, 1897. Our contemporary says that the new transatlantic cable, which will be nearly 6,000 kilometres long, will henceforth assure the independence and security of French telegraphic relations with the American continent. In consequence, the government has granted a subvention of 800,000 francs per annum for thirty years for the laying down and repair of the cable, which will be constructed and laid by exclusively French means, and will be under the control of the State.

NEWS AND NOTES.

BICYCLE TIRES AND LIGHTNING.

It has been generally asserted and supposed that a bicyclist was pretty safe in a thunderstorm, owing to the insulation from the ground afforded by his rubber tires. The case is now recorded of the death of a Mr. Walter Scott, at Chicago, who was struck by lightning while on his wheel. An inquest was held on the body of Scott. S. Carlson, a teamster, testified that Scott passed him on his wheel going south in Calumet avenue and had proceeded about fifty feet when there came a bright flash of lightning and the bicycle rider fell. When the witness reached him he was dead. The jury returned a verdict of death by shock resulting from a stroke of lightning. It was wet weather and the body as well as the machine of the victim may have been very wet. The ground around the wheel was wet with rain.

PLANTS WANTED IN MEXICO AND HAYTI.

A special dispatch from Washington of August 1 says: The United States Consul at Zurich, Switzerland, informs the State Department that the Mexican Consul there is trying to secure bids from Swiss firms on the new electric light installation for the City of Mexico. The Consul recurs to the fact that, returning to his post from home recently, he crossed the Atlantic with a Haitien who had secured the concession to light Port au Prince by electricity, and was on his way to Europe for the plant. The Consul says he had always been under the impression that the United States could beat the world on electrical appliances, and yet here is business right at our doors slipping away from us because our neighbors have been left in ignorance of our qualifications in the desired line. These neighbors undoubtedly want to purchase for the least money, and there appears to be no valid reason why Americans cannot satisfy the demand in every way.

DR. PROGER ON THE VALUE OF ELECTROZONE.

Electrolyzed salt water, besides its use as a disinfectant for sewage, is now employed as an antiseptic in Paris hospitals. Dr. Proger, chief surgeon of the Deaf and Dumb Children's Asylum at Asmeres, recently told the Académie de Médicine, as the result of long experiments, that "the electrolyzed saline water is neither caustic nor irritating; it may be applied to the mucous membrane as to the skin; it instantly removes all bad odors; stop all putrescent fermentation; kills microbes more effectually and rapidly than any other antiseptic; cleanses and heals fetid wounds and sores, and hastens healing; it is an ideal antiseptic. Consequently, it appears to me of the utmost importance to make it known, and to draw attention to all the applications that it may be put to both from a domestic point of view for deodorizing and cleaning, and from a medical point view as an antiseptic and healer par excellence." Dr. Proger used the preventive and disinfectant with success in cases of angina, coryza, and incipient diphtheria as well, the Hermite process of production being employed.

ELECTRICITY ON THE NEW CURRENCY.

The new $2 and $5 silver certificates have been printed and are ready for issue. Like the $1 certificates, they are a striking departure in money-making. Black ink is used in printing the front of the notes, while the back is of the conventional green.

The $2 note was designed by Edwin H. Blashfield, of New York, and the face contains an allegorical representation of "Science Presenting Steam and Electricity to Commerce and Manufacture," and consists of five partly nude female figures in graceful poses.

Walter Shirlaw, of New York, designed the $5 note. The face has an allegorical picture representing "America enlightening the world," a beautiful female, partly nude, holding in her right hand, uplifted, a lighted incandescent lamp. Reclining at her feet is a female figure of Fame with the traditional trumpet.

The notes are beautiful specimens of the engraver's handicraft, and in that respect will compare favorably with any work in that line.

A THREE-LEAF ELECTROSCOPE.

In a recent communication to the Académie des Sciences, M. L. Benoist described a simple improvement made by him in the gold-leaf electroscope, with a view to an increase of its sensitiveness. M. Benoist merely employs three leaves in lieu of two. When the electroscope is charged the central leaf remains rigidly vertical, whilst the two outer ones diverge equally on either side of it. The sensitiveness of such an instrument is markedly greater than that of an ordinary two-leaf electroscope, each of the outer leaves being repelled four times more powerfully by the central leaf than by the opposed leaf, so that the same divergence is obtained with a smaller charge, and that is so, although the charge is divided between three leaves. A simple calculation shows that for small angles the sensitiveness is something like 50 per cent. greater than that of a two-leaf instrument, and a general formula shows that the relative sensitiveness increases as the angle of divergence becomes greater. In a two-leaf electroscope the sensitiveness becomes zero at about 90 degrees from the vertical. With a three-leaf apparatus the limiting angle is 120 degrees.

AN ECONOMICAL ENGLISH PLANT.

For the past three months an interesting isolated plant has been in operation at Messrs. J. Snook & Co., of Nottingham. This plant includes a 60 horse-power water tube boiler, two 25 horse-power engines, one 500 light dynamo, four 6 horse-power electric motors, five electric fans, six electric irons, etc. The whole of the operations of lighting, ironing, heating and ventilating in this establishment are carried on electrically. The cost of generating power for all these varied operations during the past three months has been very carefully noted, and after allowing 10 per cent. for depreciation and all charges for wages, coal, water, oil, and sundries, the cost of generating amounts to one penny per unit.

A CANADIAN ELECTRIC LOCOMOTIVE.

The Canadian General Electric Company, at Peterboro, Ont., has been building a large electric locomtive rated at 400 horse-power. The hauling capacity is about 15 loaded freight cars at the rate of 30 miles an hour. It is proposed to use this locomotive for hauling pasenger and freight cars for the Hull Electric Company, between Hull and Aylmar.

THE

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CONTENTS.

THE EDISON CONVENTION.

THOUGH not a large body numerically, the association of Edison Illuminating Companies is one of great importance when we consider the capital invested in Edison plants, and the influence and experience of the men who manage the various companies included within its membership. There was a time when it looked as though the association would die out just as the Telephone Association did, "unwept, unhonored and unsung," but at the present hour it is perhaps stronger than ever before in its history. The mere fact that Mr. Samuel Insull is willing to assume its presidency, and that Mr. R. R. Bowker consents to stand in line for the succession, is enough to indicate that the association realizes its dignity and value and is determined to live up to its opportunities of usefulness.

It is, of course, to be regretted that the deliberations of such a body are not made public, for there are obviously many points in regard to which the data brought forward by the members is very valuable to all engaged in the industry. Still this information is not altogether buried, for we need only call attention to the elaborate articles that have appeared in The Electrical Engineer on the Edison stations in Chicago, New York, Boston, Brooklyn and Milwaukee to show that while such companies are slow in saying what they propose to do, they are willing to let the public know what they have done.

In extending to Mr. Insull our good wishes for a prosperous term of office, we need hardly dwell with emphasis on his acquaintance with both sides of the central station art,—namely, the manufacturing and the distributing aspects. While he has been known as an intensely loyal Edison man, first, last and all the time, he has been singularly successful in preserving his independence of judgment; and it is safe to say that now as president alike of the association and of the great local lighting company in the West he will preserve that independence of action so essential to the welfare of every local company in the land. In fact it might even be said that Mr. Insull's change of base from the manufacturing of apparatus to the production of current is indicative of the change that has taken place in the industry. The period when the parent companies as creators of local enterprise were all important has passed away, and the local companies are emphatically the masters of the situation instead.

TROLLEY CAR ACCIDENTS.

ANYONE who has witnessed the sufferings of horses during the recent hot weather must have thanked God that there are now 12,133 miles of electric railway in the United States, and only 1,219 of road operated by horses. Some of us can remember the times when every street car track in New York in such a hot spell was strewn with dead and disabled horses; and it is little short of marvelous that the metropolis is still willing to present a spectacle of inhumanity in this respect, and be one of the few cities where horses are tortured in this way.

But while as a general thing the horse has benefited by the change to electricity, it is sadly true that human beings have not yet derived a proper amount of safety to life from the adoption of mechanical power. Accidents are still far too numerous, and in almost every case the casualty would seem to be preventible. We give particulars of one or two recent accidents on another page, and would ask whether it is not possible by the adoption of air brakes and other means to prevent such occurrences. We will go further, and say that the non-adoption of the best appliances now readily obtainable amounts to little less than manslaughter, and that the sooner exemplary punishment is made of the lines subjecting their passengers to wholly unnecessary risks the better.

PHYSIOLOGICAL EFFECTS OF X-RAYS.

FROM the evidence of various experimenters, it is apparent that considerable more investigation will be required to determine what the physiological effects of X-rays are, or even whether any such effects are produced by them at all. The testimony on this subject is very conflicting, even taking only that of the highest authorities. Prof. J. J. Thomson, in the Rede lecture, at the University of Cambridge, states that X-rays do not exert any of those deleterious effects on bacteria which are fortunately associated with ultra-violet light. In contradiction to this statement we print elsewhere a note concerning some experiments made by Dr. William Shrader, of the Missouri State University, on the effect of Röntgen rays on disease germs. In nearly every instance the germs were found to be destroyed by the action of the rays. The experiments with diphtheria bacilli appear to be conclusive, and from other sources we have heard of a number of equally successful experiments in treating consumptive patients with X-rays, but in the face of such contradictory evidence it is necessary to suspend judgment for a time until more data on the subject is brought to light.

In respect to one effect of these rays the evidence is pretty well united. Nearly all those people who have worked extensively in this field state that wherever the rays pass through the flesh the latter becomes apparently sunburned and the hair falls off the exposed surface. This whole subject opens up a field of the utmost interest and one from which highly important results from a medical standpoint may occur.

We deeply regret to note here the death of Dr. Shrader, whose investigations are referred to above, and who died from the exhaustion caused by his unremitting study of the subject.

FAN MOTORS AS LIFE SAVERS.

FROM Wednesday, August 5, to Wednesday, August 12, there were 1,255 prostrations by heat in New York City, and 625 deaths, the temperature on the street, in the shade, seven days out of the eight reaching over 100° Fahr. This is a terrible record, and one that would have been far more ghastly, but for the passing away of the "hot wave" and the arrival of cooler weather. The record would also, we are convinced, have been more serious and the death roll longer, in New York and all over the country, but for the general use of electric ventilators and fan motors. The currents of air set in motion are the breath of life to workers of every kind, and when one has become accustomed to their mitigating influence, it seems almost impossible that other people should not eagerly seek the same boon, now so freely within reach. There are offices, restaurants, barber shops, stores, factories and houses that would simply be unendurable in such terrific heats were it not for the fan motors, large and small; and to their credit must be put an infinite amount of comfort and respite during the past two weeks.

At the same time it is obvious that much may be done yet to enhance the effects obtainable with the fan motor. The majority of them are still too large. In other words, where a fan is used for one person, the speed is very generally cut down by a resistance, simply because it is not easy to endure the tremendous breeze created when the motor is fully let out. It would seem possible to place at command fans of lower speed and less cyclonic tendencies, and it would also seem possible to improve on some of the present forms of fans, so that by different shapes of blade a greater variety of effect, at varying distances and for offices or rooms of different sizes, the required effect of coolness could be secured.

Aside from giving another great lesson in the use of electric fans, the recent hot weather, unequalled, it is said, since 1872, has offered a splendid argument for electric power in general, whether from central stations or in the distribution of energy from large isolated plants. It has been pitiable to see the condition of many men running small steam plants in confined spaces, and to reflect that in most cases a small, cool electric motor would have done the same work, with less worry and suffering on the part of the attendant and general economy for the owner of the plant.

POLICE AND FIRE ALARMS.

TWO English gentlemen from whose premises "police alarms" were recently rung in over the district messenger system, write to the newspapers complaining that no policemen came, but that after the usual long "wait between the acts" a small boy appeared to inquire what was wanted. In one case the need of help was urgent, but the boy explained that the office did not keep "bobbies" on hand and that the calls were not answered because the boxes were often "messed about." The reason for non-service thus vouchsafed was probably not without warrant, and people will certainly increase the efficiency of the district system by ringing only for what they want and only when they want it. It is worthy of mention here, in this connection, that several thermostatic fire alarm systems lately turned in a warning and turned on the water under the influence of hot weather—an evidence of alertness and fidelity in things inanimate one would hardly look for in such trying times.

A LARGE GAS ENGINE PLANT.

WE print elsewhere the first part of an abstract of a paper read before the Institution of Mechanical Engineers, at Belfast, by Victor A. H. McCowen, describing a gas engine central electric plant in that city which is rather remarkable in point of size as well as in regard to its details of equipment.

In this country the price of gas engines, and, in most places, the price of gas is far too high to permit of their being used to any considerable extent except for light, intermittent work, and almost any American engineer would hear of a similar plant of this size with a feeling of surprise. Besides the unusual fuel, the type of engine is one which we are not familiar with on this side of the water, but from the description given we should be inclined to think that the closeness of regulation necessary for the proper running of electric generators would be more certainly attained by means of the finely graduated impulses in the cylinder than would be possible with the ordinary method of missing explosions. Tests of these engines will be given in a following issue. The accounts of the plant show that the gas fuel has cost 2.9 cents per B. T. unit sold, during its first year of working, and this figure will compare very favorably, we believe, with a good many coal burning plants of the same size for the first year's operation.

SOCIETY AND CLUB NOTES.

N. Y. STATE STREET RAILWAY ASSOCIATION.

The next annual convention of this body is to be held at the Hotel Bennett, Binghamton, on Tueday, Sept. 8, at 10 a. m. This is the fourteenth meeting and promises to equal any of its predecessors in interest and importance. A long list of topics for discussion has been prepared by Mr. G. Tracy Rogers, the president, and several have already been allotted. The meeting will be followed on the same day by a general entertainment, including excursions and a banquet in the evening. It is hoped that the street railway companies of the State will be well represented; they can all count upon a very cordial reception from the Binghamton Railroad Company. Arrangements have also been made for the hospitable inclusion of supply men.

SEVENTEENTH EDISON CONVENTION.—CONEY ISLAND, AUGUST 11, 12 AND 13.

THE seventeenth convention of the Association of Edison Illuminating Companies was held at the Oriental Hotel, Manhattan Beach, Coney Island, August 11, 12 and 13, 1896.

The first session was called to order by the president, Mr. C. L. Edgar, at 11 a. m., August 11, and was devoted to the reports of committees on Welsbach light, storage battery, etc. The meeting adjourned at 1 p. m.

The second session was called to order at 2:30 p. m., when a paper was read by Mr. C. E. Pattison, of Boston, on "The Storage Battery in Actual Operation in the Boston Edison Stations." This paper gave the experience of the Boston Edison Company since the installation of its first battery several years ago, and the data as to the depreciation, maintenance, etc., was clearly stated. This paper was fully discussed by several members of companies using storage batteries.

The next paper was by W. I. Donshea and H. A. Campbell, entitled, "A Storage Battery in the New York Edison Stations." This paper gave the history of the battery in the stations of the Edison Electric Illuminating Company, of New York, from the trial of the Crompton-Howell type in the Fifty-third street station down to the present time. This paper, like its predecessor, was fully discussed and the favorable results were commented upon.

The third session was called to order August 12, at 10 a. m., by President Edgar, and was opened by a paper by Alexander Dow on "The Selection of Alternating Current Apparatus for a Central Lighting Station." This paper was immediately followed by one in the same line, entitled, "The Alternating Current System as a Pioneer," by W. S. Barstow, of Brooklyn. Both papers were then discussed and many representatives of Edison companies present gave their experience with alternating systems used in conjunction with the Edison system. The Chicago and Cincinnati companies briefly outlined the work they were doing in this direction.

The fourth session was called to order at 2:30 p. m. Mr. R. S. Hale, of Boston, read a paper on the "Wright-Demand System of Charging for Current." This was followed by interesting discussion as to the results met with in a system of discounts as outlined in a paper presented before the last convention. The Chicago, New York, Cincinnati, Brooklyn and several other companies gave their experience in the new system of charging for incandescent light.

A paper was then read by Mr. John Wolff, of Brooklyn, on "A Self-Cooling Condenser in the Second District, Brooklyn, Edison Station." This paper described the construction and operation, and gave a year's result with the apparatus in question. This paper was discussed by the Detroit and New York Edison companies.

The last paper of the convention was read by W. S. Andrews, of Schenectady, on "Some Recent Developments and Modifications of the Edison Underground System and the Use of Cables as Auxiliaries Thereto." This paper provoked an animated discussion as to the merits of the several underground systems and the use of different makes of cables.

The treasurer's report was then read and accepted, pleasure being manifested at the splendid financial condition of the association and the good work of the treasurer.

The committee on nominations then made a report of the officers for the ensuing year, which report was accepted. These officers are—President, Samuel Insull; vice-president, R. R. Bowker; secretary, W. S. Barstow; treasurer, J. W. Lieb, Jr.. Executive Committee—C. L. Edgar, Chairman; Alex. Dow, G. R. Stetson, A. W. Field, J. H. Vail. Ex-officio Members—S. Insull, R. R. Bowker, W. S. Barstow, J. W. Lieb, Jr.

During the meetings of the convention the ladies were entertained by the Brooklyn Edison Company by a visit to Sousa's concert during the second session, and a trolley party and luncheon during the third and fourth sessions (under the escort of Mr. Ethan Allen Doty), president, of the Brooklyn Edison Company). Tuesday evening, August 11, the members of the association with ladies visited Pain's Fire Works and "Cuba," and on Wednesday evening Rice's "Evangeline," both entertainments being given through the courtesy of the Brooklyn Edison Company.

Thursday, August 13, was taken up by a visit to the Schenectady works of the General Electric Company. The members of the association with ladies left Manhattan Beach on the 8 a. m. train, taking a special train from the Grand Central depot at 9:35. After the train had started the party was served with breakfast and luncheon, through the courtesy of the escorting company, and a quick trip was made, without stop, to the Schenectady works. Here the ladies of the party were given a reception by the ladies of the General Electric Company's representatives, and a drive through the country around Schenectady. During this time the members of the association were escorted through the works, where all details were fully explained and exhibited.

Mr. Steinmetz exhibited several phenomena with high tension current (as high as 150,000 volts) and a long line of newly designed alternating apparatus for transmission and distribution, meeting the admiration of all.

The special train left Schenectady on return at 5:30 in the evening, arriving at Grand Central depot at 9:45, an elaborate dinner having been provided en route.

Throughout this most delightful trip every courtesy possible was shown to the members and ladies, and it served as a fitting finale for this most successful convention.

Delegates Present—Thomas A. Edison, Llewellyn Park, Orange, N. J.; W. E. Gilmore, Edison Laboratory, Orange, N. J.

General Electric Company.—S. D. Greene, general manager lighting department; E. W. Rice, Jr., third vice-president; W. S. Andrews, manager, central station sales; A. D. Paige, manager lamp sales (incandescent lamp department); J. R. Lovejoy, manager supply department; J. W. Howell, engineer lamp works; W. S. Clark, wire and cable department; John Kruesi, mechanical engineer; Caryl D. Haskins, meter department.

Edison Electric Illuminating Company, of Atlanta.—H. T. Edgar, general manager; Jas G. Rossman, electrician.

Edison Electric Illuminating Company, of Boston.—C. L. Edgar, vice-president and general manager; C. E. Pattison, R. S. Hale.

Edison Electric Illuminating Company, of Brooklyn.—W. S. Barstow, general superintendent, W. F. Wells, electrician; John Wolff, superintendent steam plant; Theo. Guillaudeu, chief engineer; C. V. Driggs, superintendent underground department.

Chicago Edison Company.—Samuel Insull, president; Joseph Insull, Luther Stieringer.

Appleton (Wis.) Electric Light and Power Company.—A. L. Smith, president.

Electric Light Company, of Atlantic City, Camden, N. J.—E. A. Armstrong, J. E. Burleigh.

Cincinnati Edison Electric Company.—John I. Beggs, vice-president and general manager.

Cleveland (O.) Electric Illuminating Company.—Samuel Scovil, vice-president; Robert Lindsay, general superintendent.

Columbus (O.) Edison Electric Light Company.—A. W. Field, secretary and manager.

Edison Electric Illuminating Company, of Cumberland, Md.—J. S. Crider.

Des Moines (Ia.) Edison Light Company.—J. A. Colby, treasurer and general manager.

The Edison Illuminating Company, Detroit, Mich.—Alexander Dow, general manager; Hoyt Post, director; Henry Ford, chief engineer.

Elgin City (Ill.) Railway Company.—Chas. Musterfeld, manager.

New Bedford (Mass.) Gas and Edison Light Company.—G. R. Stetson, president; C. R. Price, treasurer.

The Edison Electric Illuminating Company, of New York.—R. R. Bowker, first vice-president; J. W. Lieb, Jr., general manager; W. I. Donshea, district superintendent; W. H. Lawrence, C. N. Moore, J. Van Vleck, Arthur Williams, E. A. Leslie.

The Edison Electric Light Company, of Philadelphia.—W. H. Johnson, secretary and manager; J. H. Vail, engineer in chief.

Rochester (N. Y. Gas and Electric Company.—G. A. Redman, general superintendent electric department.

Wilmington City (Del.) Electric Company.—Reginald Van Trump; A. E. Kennelly, Philadelphia.

During the convention, the electrical industries not within the ranks of the association were represented by several well-known attendants at such proceedings. The list included Messrs. E. B. Kittle, J. W. Godfrey, J. F. Outwater and Hugo

Reisinger, R. B. Corey, J. P. McQuaide, C. W. Price, S. L. Coles, T. C. Martin, T. R. Taltavall, H. L. Lufkin, S. A. Douglas, W. A. Stadelman, A. P. Eckert, W. S. Eckert, and others.

THE EDISON ASSOCIATION TRIP TO SCHENECTADY.

The Association of Edison Electric Illuminating Companies concluded its convention proceedings, held at the Oriental Hotel, Manhattan Beach, by a trip on a special train to the works of the General Electric Company, at Schenectady, N. Y. The train left the Grand Central station at 9:35 a. m., ran on the schedule of the Empire State Express, and reached Schenectady at 1:40 p. m., when it was switched into the yards of the company. A large number of the delegates accepted the invitation and the few who excused themselves on account of the heat, had reason to regret their decision, the weather being much cooler and more bearable on the train than at the beach.

On the arrival of the delegates at Schenectady, they were received by Mr. E. W. Rice, Jr., third vice president; G. L. Emmons, superintendent of the works; A. L. Rohrer, and a corps of engineers. The delegates first visited that part of the factory devoted to the manufacture of the smaller classes of supplies, such as sockets, cut-outs, switches, lightning arresters, commutators, etc., etc. The switchboard department next occupied their attention, and considerable admiration was expressed at its magnitude and the intricate and beautiful work in process of completion. Adjoining this, search lights are manufactured, and some idea was gathered of the extent of the business in this direction by the number of projectors under construction and test. A climb to the projector testing platform gave the delegates a splendid bird's-eye view of the entire works lying on the banks of the Mohawk River, covering 43.21 acres, 76 buildings in all with a floor space of 681,553 square feet, in which all the machinery is driven by electricity.

A glance was given into the brass punching shop, the store house and the porcelain works, where all the porcelain bases for sockets, switches, cut-outs, small cleats, etc., as well as the heavy insulators for long distance transmission work are made. These are tested to 50,000 volts alternating before shipment.

The visitors were then conducted to the main factory and passing by the big foundry, entered the shop devoted to the manufacture of heavy dynamos. Here they saw generators of all sizes from the small ¾ kilowatt to the great 1,500 kilowatt in all steps of manufacture. Already under way were the three-phase dynamos to be used in the transmission of power to Salt Lake City from a point 36 miles distant, similar in character to those now generating current at the Big Cottonwood Stairs for transmission to the same city: Rotary converters for the conversion of power, for Buffalo, transmitted from Niagara Falls, monocyclic generators, railway generators, direct current lighting generators, induction motors of all sizes, small direct connected sets for marine work, etc., etc.

Considerable attention was given to the new testing shop, just completed, in which apparatus of the character mentioned above was undergoing careful test under the eyes of a body of bright active young men. The next shop visited was the wire and cable shop, containing on the ground floor the rubber manipulating stranding, insulating and vulcanizing machinery, and on the upper floor the braiding machinery and the printing office. A sniff was given to the compound shop where the insulating compound is put on the wires, but the delegates refrained from entering.

Passing the power house, in which all the boilers, steam engines and working generators are confined the visitors reached the building in which the Siemens cables are manufactured, and were shown the operation of the great lead presses. Here too, they saw the manufacture of the armature coils and commutator leads, on forms, ready for placing in complete shape on the cores in the adjoining room.

At the far end of the ground is building No. 20, in which the armature laminations are punched and toothed. Here the striking features of the monocyclic system are demonstrated in an experimental plant. The current at 1,000 volts is taken from a monocyclic generator and raised to 21,000 volts in two 35 kilowatt oil insulated transformers. At this pressure it passes to a line about 3,100 feet long, which terminates at the punch house in two similar step-down transformers which reduce the pressure to 110 volts. At this pressure it is turned into the induction motors which drive all the punch presses, and into arc and incandescent lamps.

The visitors were then treated by Mr. Steinmetz to an experiment with very high voltage currents. This consisted in producing an arc at 150,000 volts between terminals about 15 inches apart. Four large oil insulators were used to bring the current up to the required pressure. The arc which was formed appeared as a beautiful undulating pink flash which hung waving in the air for about ten seconds, and was then drawn upwards to vanish as soon as its length had reached four feet or more. Various pressures were used from 70,000 volts up, between varying distances, the effect being always the production of the beautiful evanescent arc.

The next building visited contained the 30-ton electric locomotive now being overhauled and put into condition for use on a branch of the New York, New Haven and Hartford Railway. In view of the fact that the Pennsylvania Company have practically abandoned for the time their experiments with other systems of electric traction, the fact that the N. Y., N. H. & H. R. R. people, who are doing so much to introduce electric traction on their lines, continue to adopt the methods and apparatus of the General Electric Company is interesting.

A visit to the show room of the supply department, containing samples of the new long-burning arc lamps, and improved double carbon lamps, concluded the tour through the works.

The visitors re-embarked on the special train at 5:40 p. m., and reached New York at 9:40 p. m.

The trip was made under the care of Mr. S. Dana Greene, assistant general manager and manager of the lighting department, to whose genial courtesy and urbanity is entirely due the pleasure which each visitor experienced and acknowledged.

It may be mentioned as an evidence of the pains taken to render the trip through the Schenectady works complete, as well as interesting, that each of the guides was furnished with an elaborate miniature blue print marking the itinerary from shop to shop, the arrow heads indicating the routes in and out. This systematic method enabled the visitors to cover a large extent of territory and yet to pause as long as they chose at any point where special features demanded study.

LETTERS TO THE EDITOR.

ANOTHER FLATTENED LAMP.

Referring to the article entitled, "A Peculiar Lamp Accident," on page 148 of your issue of August 12, I beg to say that I send you to-day under separate cover an incandescent lamp similarly distorted. This lamp was found by one of the Inspectors of this association in the kitchen of a dwelling which had been damaged by a fire caused by the explosion of a gasoline stove. The fire was undoubtedly hot enough to soften the glass bulb of the lamp, and the pressure of the outer air on the softened bulb containing vacuum, was sufficient to bend the lamp into its present shape.

Philadelphia Fire Underwriters' Association, Philadelphia, August 13, 1896.

CHAS. A. HEXAMER, Secretary.

(The lamp sent us has the glass globe intact, but is badly flattened and is folded up upon itself, very much in the style of a dried pear. Eds. E. E.).

LITERATURE.

A BRIEF HISTORY OF OLD FORT NIAGARA.—This pamphlet by Mr. Hugh Porter, of Niagara Falls, illustrated by half tone cuts made from photographs by Mr. Orrin E. Dunlap, is interesting and timely at this period when the region and spot it refers to are attracting so much attention. Mr. Porter tells his story in a simple, direct manner and brings out a number of curious and pathetic details in regard to the struggle for ownership of the Niagara valley. The pamphlet is well printed, and the cuts are excellent.

PERSONAL.

MR. ELMER P. MORRIS has been appointed agent in the East for the Electric Railway Equipment Company, of Cincinnati, O., and has taken an office at 36 Dey street, New York. This company are large manufacturers of iron and steel poles for electric railway work, and also of all kinds of line material and motor parts. They have recently largely increased their facilities, and will carry a handsome line of samples in New York. Mr. Morris is also agent for the Simplex Interior Telephone Company, and the Bradford Belting Company, both of Cincinnati.

MR. C. S. BIDWELL, who has been electrician and mechanical superintendent for the Ashtabula Rapid Transit Company since the line was put in operation four years ago last April, has severed his connection with the company. The Trumbull Electric Company, of Warren, O., has elected Mr. Bidwell to the position of general superintendent for the company. The line of which he will have change is eight miles in length, extending from Warren to Niles and connecting with the line from Niles to Youngstown.

A MODERN VILLAGE LIGHTING PLANT.—NORWOOD, OHIO.

BY THOS. G. SMITH JR., M. E.

WHILE all are familiar with the use of direct, constant potential current for operating incandescent lamps and motors, the application of this character of current to the operation of arc lamps for street service is in a measure new, and a description of one of the latest installations for this purpose may be of interest.

The plant about to be described is used primarily for the illumination of the streets of the village of Norwood, Ohio, and it is intended ultimately to furnish current for commercial purposes as well. At the present time the service is almost wholly devoted to the street lighting, with the exception of some 20 incandescent lamps in the station building and some few others now being connected on the commercial circuits. The street lights consist of about 150 arc lamps operated two in series on 220 volts. This is the largest number of lights of this type, so far in use in any village lighting plant in this section of the country; and this station is probably the only one operating street lights exclusively, or in which the incandescent service is a small fraction of the entire load.

The station is a one-story brick structure, with slate roof, built as an addition to the waterworks station; it is designed for the accommodation of three units of the present size, without encroaching on the space devoted to office purposes. The station has three exposures, south, west and north, with a gallery along the west end, forming a convenient storage and testing room.

The present generating unit consists of one 135 kilowatt multipolar, slow speed dynamo mounted on the shaft of a 200 horse-power cross-compound, fixed cut-off engine; dynamo and fly-wheel located between the engine bearings. The dynamo is of the Siemens & Halske make, with outside commutator, and is fitted with their latest form of independent brush holder ring which is mounted on an adjustable pedestal, with roller bearings at three points; this ring is controlled by a hand wheel at the rear of the dynamo. The machine is compound wound and automatic in regulation.

The engine is of the cross-compound, fixed cut-off type built by Houston, Stanwood & Gamble, with a capacity of 200 horse-power, at 150 revolutions per minute, and 100 lbs. steam pressure, non-condensing. The engine frames are mounted on a sub-base which also furnishes support for two of the roller bearings for the brush holder ring. The combination of a heavy fly-wheel with a high speed form of throttling governor, gives excellent practical regulation.

The switchboard is of white marble fixed in a neatly finished oak frame, located at the center of the east side of the building, three feet from the wall. On this board are mounted the instruments and switches for the control and operation of the plant, as follows: Ampere and volt meters, of the Weston circular pattern; main and circuit switches of the Electric Engineering and Supply Company, tubular frame type; Westinghouse circuit-breaker; voltmeter switch; ground detectors; rheostat hand wheel and switchboard lights. The circuits from the board are carried overhead and out from a wire tower located centrally on the roof.

The system of distribution is virtually a double two-wire system, having three wires so arranged that one is the common negative and the other two are separate positives; one of the latter being for the arc circuit and one for the commercial circuit. This enables a separation of the arc and commercial services controllable at the station.

There are two centers of distribution to which feeders are run and from which sub-feeders lead to distributing mains. There are two of these mains which form closed rings about the territory to be covered, and are connected by tie mains. The lamp loops are connected across the mains, and in some cases between the mains and the sub-feeders. The line poles are 30 feet long and the lamp poles 35 feet, all set one-fifth of their length in the ground, and guys are avoided where possible. The lamps are suspended from ⅜-inch galvanized, stranded steel cable secured to the heads of the poles by means of adjustable eye-bolts. Sleet-proof pulleys are used, one in the center of the cables and the other swiveled to the poles. The hoisting ropes are ¼-inch galvanized stranded steel cables, with hemp core, and are secured at lower end by oblong rings slipped over hooked pins, with "Yale" padlocks fastened through the eye in the hook. The arc lamps are of the "Manhattan" enclosed type, designed to operate two in series on 220 volts, consuming four amperes per pair of lamps, and burning 150 hours with one pair of carbons without readjustment.

The results of operation have been gratifying on account of mellow, steady light, with such perfect diffusion as to cause entire absence of shadow under the lamps; also uniformity of current consumption, with very low flushing current on starting. Both ampere and volt-meter needles stand perfectly steady during the operation of the plant, giving an excellent illustration of the uniformity of the load.

The incandescent lamps are 220 volt 16 candle-power lamps, with single filaments, and so far as we have been able to judge are a success; they appear to withstand a greater range of voltage than the 110 and 50 volt lamps. In fact we have run some of our lamps on over 265 volts for considerable periods of time without noticeable injury.

The operation of this plant, though extending over only a short time, has been of such satisfactory a nature as to impress all who have examined it, beside proving a complete refutation of many vehement statements made by the representatives of some of our leading manufacturers of series lamps.

Persons interested in the installation of lighting plants for this purpose or in the improvement of existing plants, will find the examination of this plant valuable to them, and the writer will be pleased to furnish any further information that may be desired.

ELECTRICAL INSPECTION IN PITTSBURG.

About a year ago a scheme was conceived by Morris Mead, the city electrician, which has proven to be of much good to the city of Pittsburg. The idea was to have the erection, construction and inspection of all appliances used for electrical purposes placed under the supervision of the department of public safety in order that safety, comfort, convenience and welfare of the people, and also protection from careless or negligent use of dangerous substances might be insured. Experience has shown, says the local "Leader," that in the construction and increase of wires and appliances used for electrical purposes upon the public streets and in private buildings there is great danger to life and property. Many fires have been caused by bad wires and severe shocks have been sustained by coming in contact with a wire that has become uninsulated by rubbing against something. Until that time no adequate means had been provided by the city for placing the control of such wires and appliances in the hands of the department of public safety, and an ordinance granting this privilege was passed.

The ordinance provided that the department of public safety be given the supervision over all electrical conductors now in use in the city, which includes telegraph, telephone, trolley and other lines and appliances in which electricity is used, and the construction thereof. It also vested the department with the power to supervise the construction of wires and appliances used in private houses, and gave them the right to prohibit the use of either wire or appliance that would be defective or dangerous, either in material or workmanship.

A number of inspectors were appointed, whose duty it is to visit buildings and thoroughly examine the electric wires or appliances therein. If a defect is found the owner of the building is notified to attend to it at once, and the refusal to take cognizance of this notice subjects the offender to severe punishment. Since the adoption of this new idea—eleven months ago—1,339 buildings have been inspected, which is on an average of 122 per month, to say nothing of the outdoor work that has been done. Many defects have been found, and on many occasions these would have been the cause of much damage had they not been attended to. The city, in this respect, is in a very good condition at present, which is due to the passing of the said ordinance. No fires of any account have been reported as caused by defective electric wires, and many accidents among machinists who have to tinker with electrical apparatus have been avoided. The scheme was a good one, and as time goes by the benefits derived therefrom will be more noticeable.

THE PACHUCA, MEX., POWER TRANSMISSION.

The Regio Electric Power Transmission Company of Pachuca will begin the last of this month to send power into that important mining city from Water Falls, 25 miles distant, and it is estimated it will be able to furnish 1,200 horse-power. Several great reduction works will take this power at an annual charge of $250 per horse-power per 24 continuous hours. The Pelton water wheels are employed, and all machinery and supplies are from the United States.

PATERSON, N. J.—A big burst in the Main street water main is attributed to electrolytic action due to escaping railway current. There is no proof, however, that the alleged cause of the trouble is the real one.

Synopsis of Current Electrical Literature.

EDITED BY MAX OSTERBERG, E. E.

Biographical:

SIR WILLIAM R. GROVE.—Obituary.—"Elec. World," Aug. 8, '96.

Central Stations:

READING ELECTRICITY WORKS.—An interesting and well illustrated description of an alternating current plant.—Lond. "Lightning," July 30, '96.

Dynamos and Motors:

LOAD LOSSES IN DYNAMOS.—By W. M. Mordey. A note bearing on Mr. Blathy's load loss. (See Synopsis, Aug. 5, '96.)—Lond. "Elec.," July 30, '96.

Electro-Chemistry:

IMPROVEMENTS IN THERMO-ELECTRIC BATTERIES.—By James Asher. Several methods of securing good economy in the Clamont type of thermo-electric batteries.—"Elec. Rev.," Aug. 12, '96.

THE THERMO-TROPIC BATTERY AND A NEW METHOD OF DEVELOPING ELECTRICAL ENERGY.—By C. J. Reed. Writer thinks to have discovered a new phenomenon which he briefly describes in "Elec. World," Aug. 8, '96.

Isolated Plant:

ELECTRICITY ON THE ST. PAUL.—By Joseph W. Gavan. Five generating sets are installed, each of which consists of a dynamo of 360 amperes at 115 volts and is direct coupled to a marine engine of 475 revolutions per minute. The rudder is operated by electricity.—"Elec. Doings," August, '96.

LIGHTING IN ELECTRIC SQUARE, BUFFALO.—Description of a large isolated plant. Current is generated in four direct connected units. Three of the engines of 160 horse-power each drive 100 kilowatt generators, one 115 horse-power engine drives a 75 kilowatt dynamo. 145,000 feet of conduit and 290,000 feet of single wire are in the building. Further details in "West. Elec.," Aug. 8, '96.

Lighting:

A NEW SYSTEM FOR ELECTRIC ILLUMINATION OF STAIRCASES.—Description of a device said to be patented by the Allgem. Elektr. Ges., by means of which all the lights may be turned on or off from any floor. (This hardly seems to be a patentable invention, since every good wireman can and has done the same thing for years past in this country.—Ed.)—"Leitschr. für Beleuchtungswesen," July 30, '96.

THE EVOLUTION OF ARTIFICIAL LIGHT AND LOCATING AND RELOCATING THE LIGHTING FIXTURES.—By Henry Hopkins. Paper read at the recent session of the Street Lighting Convention at New Haven, Conn. The author traces in a short but interesting manner the first stages of lighting.—"Elec. Doings," August, '96.

ELECTRICITY IN PRIVATE HOUSES.—By Theodore Waters. See Transmission and Power.

Measurements:

AN ELECTRIC FREQUENCY TELLER.—By Albert Campbell, B. A. A portable instrument which depends on resonance for its working.—Lond. "Elec.," July 31, '96.

Miscellaneous:

INSURANCE OF ELECTRICAL PLANTS.—By R. H. Pierce. Paper read before the Northwestern Electrical Association. After a general introduction, author gives the requirements for standard electric light and power stations.—"Elec. Rev.," Aug. 12, '96.

ELECTRICALLY HARDENED STEEL.—A Swiss engineer by the name of Vaux is credited with this invention, a short notice of which appeared in the "Am. Man. and Iron World," Aug. 7, '96.

RIGHTS OF ELECTRICAL COMPANIES.—By W. Clyde Jones. Paper read before the semi-annual meeting of the Northwestern Electrical Assoc. Author discussed the following points: (1) Relation of the electrical industry to the governing power upon whom it depends for the exercise of the essential franchise for the use of the streets and highways; (2) the relation to private persons and abutting property owners; (3) the relations between various companies, electrical and otherwise, which conflict in the exercise of their franchises.—"Am. Gas Light Journ.," Aug. 10, '96.

Power Transmission:

ELECTRICITY IN PRIVATE HOUSES.—By Theodore Waters. Author describes a modern dwelling, paying special attention to elevators, which are easily controlled, and which require no attendants.—"Elec. World," Aug. 8, '96.

MEASUREMENT OF INSULATION RESISTANCE OF STREET RAILWAY CABLES.—By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D. A method by means of loss of charge measured with a condenser is explained and demonstrated with a numerical example.—"Elec. World," Aug. 8, '96.

Roentgen Rays:

ROENTGEN RAYS OR STREAMS.—By Nikola Tesla. A highly interesting communication, in which the author gives additional information in support of his theory of material particles.—"Elec. Rev.," Aug. 12, '96.

DELETERIOUS EFFECTS OF X-RAYS ON THE HUMAN BODY.—Mr. H. D. Hawks, who has been exhibiting the Röntgen ray apparatus is suffering from peculiar burns of the skin, which he thinks are directly attributable to the Röntgen ray effects.—"Elec. Rev.," Aug. 12, '96.

THE SURVIVING HYPOTHESIS CONCERNING THE X-RAY.—See Synopsis Aug. 5; also "Electricity," Aug. 5, '96.

Railways:

THE SYSTEM OF THE CONSOLIDATED TRACTION COMPANY, of New Jersey. An extended description of the entire system, with many illustrations and a map showing the location of all the lines.—"Street R'way Journ.," August, '96.

RECENT ELECTRICAL OVERHEAD WORK IN SAN FRANCISCO.—By S. L. Foster. Two salient features are especially mentioned; first, the poles are designed, built and set for a given strain and no more than the expected strain is put upon them; second, the height of the trolley wire is twenty-one feet above the rail. A number of views illustrate the mode of construction.—"Street R'way Journ.," August, '96.

STATISTICS OF MILEAGE, CARS AND CAPITALIZATION OF AMERICAN STREET RAILWAY COMPANIES.—We herewith give the total for the United States:

No. of roads, 916:
Horse.—Miles, 1,219; cars, 5,383.
Electric.—Miles, 12,133; cars (motor) 26,242; cars (trailers) 8,729.
Cable.—Miles, 599; grip cars, 3,329; trail cars, 1,542.
Miscell.—Miles, 519; dummy engines, 760; coaches, 2,197.
Total.—Miles, 14,470; cars, 48,182.
Capital Stock.—Total, $784,813,781; per mile track, $54,200.
Funded Debt.—Total, $590,596,391; per mile track, $40,800.
Capital Liabilities.—Total, $8,375,410,172; per mile track, $95,000.—"Street R'way Journ.," August, '96.

Telephony, Telegraphy, etc:

MECHANICAL FEATURES OF TELEPHONE LINES.—By Dr. V. Wietlisbach, of Berne, Switzerland. Theoretical discussion of the subject.—"Elec. Eng'ing," August, '96.

WHALES TO BE KILLED BY ELECTRICITY.

An apparatus for electrocuting whales is described by the Boston "Journal of Commerce." A dynamo, with power-producing apparatus, is to be placed on a whaler, and not used until the whaling grounds are reached. On board there is to be placed a big reel of insulated wire, which is to be placed in a boat when a whale is sighted. One end of the wire is connected with the dynamo, and at the other end, which will be in the boat, will be a hard rubber stick, about four feet long. The wire is carried through the rubber stick, and is attached to a piece of metal twenty-four inches long and one inch in diameter. This metal rod is sharp at the end, so as to penetrate the flesh of the whale easily. The combined rubber and metal rods will be used just as a harpoon is now used, and when near the big fish the harpooner will throw the electric barb. At the time of striking there will be a current of 10,000 volts running through the wire. When the point of the needle strikes the whale, a current connection will be formed with the dynamo, the whale will get the full shock of the high voltage, and will be dead in the fraction of a second. At least this is the calculation of the enterprising captain of the whaler.

UNION CITY, IND.—Mr. J. B. Bailey, Jr., manager of the Toledo, O., Cedar Company, advises us that a telephone plant is to be installed at Union City and Winchester, Ind., and that the two towns will be connected by a toll line.

BATH, ME.—N. G. Shaw & Sons are planning to equip their big sawmill with electricity as a motive power next season.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 11, 1896.

Alarms and Signals:—

RAILWAY-CROSSING SIGNAL. J. Sheecraft, Harveyville, Kas., 565,518. Filed September 17, 1895.
Operated by train approaching in either direction.

ELECTRIC TIME-ALARM. Herbert E. Lipscomb, Richmond, Va., 565,761. Filed June 18, 1896.
Details of construction.

AUTOMATIC SIGNAL. John Pressley Coleman, Edgewood Park Penna., 565,839. Filed June 1, 1896.
Comprises a pivotally-mounted blade and floating lever pivotally mounted to the signal-blade, and two independent motors connected one to each end of the floating lever.

Secondary Batteries:—

CHARGING AND DISCHARGING SECONDARY BATTERIES. Edw. N. Dickerson, New York, N. Y. 565,727. Filed May 26, 1892.
Consists in combining a thermopile with electrical control from the secondary battery, whereby the said thermal source of electricity shall be put in operation whenever required by the battery for the purpose of charging.

STORAGE-BATTERY SYSTEM. Fred. D'A. Goold, Brooklyn, N. Y., 565,741. Filed February 27, 1896.
Means whereby a low-tension continuous current can be employed to charge several groups of storage-cells, group by group, at a transformer-station.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. Fred. D'A. Goold, New York, N. Y., 565,740. Filed November 2, 1895.
The combination of several sections of storage-cells connected in series in a permanent order for charging, a consumption-circuit requiring a current of lower tension than the charging-current, and means independent of the series circuit for successively connecting the sections of cells to the consumption-circuit.

Dynamos and Motors:—

DYNAMO-ELECTRIC MACHINE. E. Caemmerer and F. G. Mayer, Chicago, Ill., 565,529. Filed December 4, 1895.
Consists of a field-magnet comprising a core requiring only one magnet-coil, a sleeve adapted to contain said core, and pole-shoes on said sleeve and said core arranged alternately and forming two equal magnetic fields at the ends of said sleeve and said core in which the armatures are adapted to revolve.

DYNAMO-ELECTRIC MACHINE. E. Caemmerer and F. G. Mayer, Chicago, Ill., 565,530. Filed December 4, 1895.
A field-magnet comprising an outer casing, and a core situated within said casing and supported upon non-magnetic supports.

ARMATURE FOR DYNAMO-ELECTRIC MACHINES. D. P. Thomson and A. H. Armstrong, Schenectady, N. Y., 565,647. Filed May 13, 1896.
Comprises a core having slots, the sides of which are parallel, the radii passing through their centers, L-shaped teeth having undercut portions, coils, each occupying an aliquot portion of the slot, and wedges engaging with the undercut portion of the teeth for retaining the coils in place.

CUT-OUT FOR ELECTRIC MOTORS. Ernest P. Warner, Chicago, Ill., 565,867. Filed March 5, 1895.
Details of construction.

Lamps and Appurtenances:—

SOCKET FOR INCANDESCENT LAMPS. Harvey Hubbell, Bridgeport, Conn., 565,541. Filed June 6, 1896.
A pull-socket.

METHOD OF MANUFACTURING INCANDESCENT LAMPS. Frank S. Smith, Pittsburg, Pa., and James A. Vandergrift, Allegheny, Pa., 565,576. Filed January 31, 1895.
Means for supporting and protecting incandescent lamps during the process of fusing and annealing the same.

ADVERTISING ELECTRICAL PHOSPHORESCENT LETTERS OR SIGNS. Daniel McFarlan Moore, New York, N. Y., 565,775: Filed January 7, 1895.
Consists of an electrical conductor shaped into a letter, an evacuated inclosure containing the conductor, and means for interrupting and closing the electric conductor within the inclosure.

PHOSPHORESCENT ELECTRICAL ILLUMINATION BY METALLIC COATING UPON GLASS. Daniel McFarlan Moore, New York, N. Y., 565,776. Filed January 24, 1895.
Consists of an evacuated inclosure, a metallic coating formed upon the surface thereof, relatively yielding electric terminals within the evacuated inclosure, an electric conductor connecting one of the terminals with the coating, and means for rapidly alternately opening and closing the terminals.

PHOSPHORESCENT ELECTRICAL ILLUMINATION BY SECONDARY CURRENTS. Daniel McFarlan Moore, New York, N. Y., 565,777. Filed January 24, 1895.
Similar to above.

ELECTRIC ARC LAMP. John A. Mosher and Wm. Batholomew, Chicago, Ill., 565,861. Filed Sept. 23, 1895.
Comprises a frame having vertical guide-rods, a carbon holder adapted to slide upon the guide-rods and having a knife-edge bearing thereupon.

FILLING FOR INCANDESCENT LAMPS. Jas. McFarlane, Glasgow, and Wm. Burges Edgar, Partick, Scotland, 565,862. Filed June 27, 1894.
A moveable contact having a tread arranged for engagement on opposite sides, and an oppositely-acting wedge engaging alternately with opposite sides of the tread and mounted upon an axially-moving key arranged transversely to the movement of the contact.

Miscellaneous:—

ELECTRICALLY-OPERATED SHEDDING MECHANISM FOR LOOMS. Elmer Gates, Philadelphia, Pa., 565,446. Filed August 5, 1895.
In a loom, in combination a pair of solenoids, an electric circuit, means for throwing said solenoids alternately into and out of circuit, a core or magnetizable device, a warp thread eye, and devices connective of said eye and said core.

ELECTRICALLY-OPERATED JACQUARD MECHANISM FOR LOOMS. Elmer Gates, Philadelphia, Pa., 565,447. Filed August 5, 1895.
In a loom, in combination, a pattern sheet embodying conducting spaces, a roll in contact with said sheet, electrically actuated mechanism to occasion the rotation of said roll, a conducting wire leading to said mechanism and equipped with a switch adapted to be thrown by a moving part of the loom.

ELECTRICALLY-OPERATED REED FOR LOOMS. Elmer Gates, Philadelphia, Pa., 565,448. Filed August 5, 1895.
Similar to above.

MAGNETIC SHUTTLE-MOTION FOR LOOMS. Elmer Gates, Philadelphia, Pa., 565,449. Filed August 5, 1895.
Details of construction.

APPARATUS FOR TREATING SEWAGE. Oluf E. Meyer, Milwaukee, Wis., 565,491. Filed March 4, 1890.
Embodies an electric screen through which the liquid is caused to pass, and by which the organic matter contained therein is oxidized.

ELECTRIC CIGAR LIGHTER. Friedrich Wilhelm Schindler-Jenny, Kennelbach, Austria-Hungary, 565,571. Filed October 2, 1895.
A glow wire and a resistance wire are both placed in the same casing.

ELECTROLYTIC SEPARATION OF VEGETABLE FIBERS. Bertrand S. Summers and Chas. O. Boring, Chicago, Ill., 565,706. Filed November 4, 1895.
The fibers are subjected to electrolytic action in the presence of a solution which is adapted to destroy the gum while not affecting the fibers themselves.

ELECTRIC HEATER. R. Van R. Sill, Cleveland O., 565,574. Filed March 20, 1896.
A hermetically-sealed radiator having vertical chambers communicating with each other at their upper ends, a comminuted resistance filling said radiator and an electrode extending into the lower end of each chamber, and having contact with the resistance material.

ELECTRICALLY-OPERATED STRINGED MUSICAL INSTRUMENT. Willard H. Gilman, Boston, Mass., 565,739. Filed July 21, 1894.
A banjo to which metallic fingers are attached which fret and pick the strings, the fingers being actuated by electromagnets.

Railway Appliances:—

ELECTRIC RAILWAY. William Grunow, Jr., Bridgeport, Conn., 565,453. Filed August 27, 1895.
For description see page 180.

ELECTRIC CONDUIT RAILWAY. John B. Linn, Cleveland, O., 565,624. Filed January 11, 1895.

ELECTRICAL VEGETATION EXTERMINATOR. Marshal S. Cummings, Thomasville, Ga., 565,671. Filed April 30, 1896.
A current distributor adjustably suspended from a vehicle so as to contact with adjacent vegetation.

RAIL BOND. F. H. Daniels, Worcester, Mass., 565,672. Filed June 20, 1896.
The terminal is provided with an opening for a drift-pin.

TROLLEY WHEEL. John B. Dailey, Philadelphia, Pa., 565,725. Filed October 22, 1896.
Comprises a trolley wheel and two grooved pulleys, one upon either side of said wheel, journaled upon the shaft, and contact springs adapted to bear against the ends of said pulleys.

Switches, Cut-Outs etc.:—

ELECTRIC SWITCH. C. Bach, Jr., Milwaukee, Wis., 565,662. Filed November 11, 1895.
A knife switch blade having a handle in pivotal connection therewith, a slotted handle engaging bracket provided with a forwardly extending foot, and a spiral spring connecting the handle with the bracket foot.

ELECTRIC SWITCH. William L. Denio, Rochester, N. Y., 565,673. Filed January 25, 1894.
Especially adapted for use on signal lines.

SWITCHBOARD FOR ELECTRICAL DISTRIBUTION SYSTEMS, Lewis B. Stillwell, Pittsburg, Pa., 565,811. Filed August 6, 1895.
Two sets of cylindrical bus bars, each of which comprises a plurality of sections differing in size and joined end to end; a series of feeder switches and a series of dynamo switches connected alternately to said bus bars and means for actuating said switches.

Telegraphs:—

PHOTOGRAPHIC TELEGRAPH RECORDER. Clement Ader, Paris, France, 565,657. Filed October 24, 1895.
Details of construction.

Telephones:—

TELEPHONE-EXCHANGE SYSTEM. Albert F. W. Meyer, Blue Island, Ill., 565,627. Filed August 8, 1895.
A switchboard having contact plugs, subscribers' lines leading immediately to said plugs without passing intermediately through any form of resistance, said plugs forming the terminals of said subscribers' lines and line annunciators in the ground branches from the grounding plates on which said plugs rest.

MULTIPLE SWITCHBOARD. Robert McGuire Andrews, Richmond, Va., 565,823. Filed April 17, 1896.
Details of construction.

REPORTS OF COMPANIES.

NEW YORK EDISON EARNINGS.

Treasurer Williams, of the Edison Electric Illuminating Company of New York, gives the following July earnings, inclusive of high tension systems:

	1896.	1895.	Increase.
Gross	$ 156,891.32	$ 135,693.59	$ 21,197.73
Net	67,270.56	58,533.59	8,736.97
Gross, 7 months ...	$1,262,795.96	$1,151,641.78	$111,154.18
Net, 7 months	611,803.55	549,535.91	62,267.64

"SILVER SCARE."

With regard to several proposed new enterprises, the information that has reached us takes a stereotyped form, as follows: "Nothing definite yet; silver scare is in the way."

LEGAL NOTES.

INJUNCTION AGAINST THE WALKER COMPANY.

The General Electric Company has secured a temporary injunction against the Walker Company and Charles N. King, of Jersey City and Cleveland, restraining them from making and using a certain form of trolley described in patent 495,443 as a "traveling contact for electric railways." This suit is one of a large number which have been brought by the General Electric Company on its two fundamental railway patents, the underrunning trolley and the overhead switch. Nineteen suits have been brought against railways and manufacturers on the former and thirteen on the latter patent, and in no case has a temporary injunction been denied. The trolley patent was established by Judge Townsend in the suit against the Winchester avenue railway, and the overhead switch patent was sustained by Judge Coxe, in the suit against the Elmira and Horseheads railway, his decision being affirmed afterwards by the Court of Appeals.

It will be remembered that the United States Circuit Court of Appeals, sitting in New York, on July 29, greatly modified the Townsend decision as to trolley bases, and left the street railway companies freer to buy where and of whom they chose. This decision was given in our issue of August 5.

MONEY CLAIMED FOR A FENDER.

Ulysses B. Stuart, through his attorney, A. S. L. Shields, has begun suit in the Philadelphia Common Pleas Court against the Philadelphia Traction Company and George D. Widener, to recover $100,000 damages for alleged breach of contract. The plaintiff states that during the month of November, 1894, Mr. Widener, who was vice-president of the Philadelphia Traction Company, on his own behalf and on behalf of the company, verbally agreed with the plaintiff that if he would invent and produce a new and useful car fender that would prevent persons from being injured he would receive $100,000.

The plaintiff states that he carried out his part of the verbal contract and invented the fender, but in April, 1895, when he requested payment of $100,000 it was refused.

OBITUARY.

DR. J. A. MONELL.

Dr. Joseph Augustus Monell, who had been a practicing physician in this city for about forty-five years, died last week. He was born in Middletown, N. Y., in 1826. He was graduated from a medical college in Philadelphia, and afterwards from the College of Physicians and Surgeons of this city. He was a member of the New York County Medical Society, the New York Academy of Medicine, the New York Pathological Society, the Physicians' Mutual Aid Society and the New York Electrical Society, electricity being a subject that interested him greatly. His widow and a son survive him.

W. G. CAMERON.

William G. Cameron, forty years old, an electrician and contractor, of Woodside, L. I., was killed on Wednesday night last in the power house of the Steinway Electric Railroad, Astoria, Long Island. Mr. Cameron built part of the Steinway Road, and was known to all the engineers and workers about the power house.

After returning from New York City Wednesday night, Mr. Cameron went into the power house to converse with the engineers for a few minutes. He went into the motor room for a short time, and then disappeared. The engineers thought he had gone into another room. He, however, had been caught in the shafting. His body was whirled around by the belt, and the first the engineers knew of his being in the machinery was when he uttered a cry.

On looking into the machinery, the engineers saw his body dashed against a side wall of the building, and fall to the ground, a distance of forty feet. When reached Mr. Cameron was dead. His body had been crushed in a terrible manner.

EDWARD MAY.

Mr. Edward May, president of the Mount Morris Electric Light Company, died suddenly in his office at Van Dam and Greenwich streets at 6 o'clock p. m., on August 10, during the extremely hot weather. Mr. May was overcome by a sudden illness and an ambulance was summoned. When the surgeon arrived, however, Mr. May was dead. Mr. May was born in Minden, Westphalia, Germany, fifty-two years ago, and came to the United States in 1867. He afterwards became interested in electrical concerns, and together with his brother Julius and other capitalists he organized the Mount Morris Electric Light Company. This company was one of the pioneers in the electric lighting business in this city, and when the majority of the other electric lighting companies opposed the placing of the wires underground the Mount Morris company advocated the measure. In addition to being the president of the Mount Morris company, Mr. May was also president of the Yonkers Electric Light and Power Company, vice-president of the Globe Electrical Construction Company and vice-president of the Eagle Gold Mining Company.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

PIONEER ENCLOSED ARCS.

We hear that the business of the Electric Arc Light Company has increased so rapidly of late on account of the wonderful success of the "Pioneer" enclosed arc 150 hour lamp that additional forces are required in the active management. Mr. J. H. Astruck, well known downtown as a bright and courteous business man, has joined the already strong staff of the "Pioneer." Prof. L. B. Marks, the chief electrician, has charge of the scientific end. Mr. Joseph Bijur has the factory in charge and Messrs. Hubbard & Armstrong have the city sales department in charge. Arrangements have thus been made to handle a very large business most readily.

THE YAUX ELECTRICALLY TEMPERED STEEL TOOLS.

From European sources comes a report of the experiments carried out by M. Yaux, of Strasburg, in the presence of a committee of engineers. It appears that a drill tempered by electricity penetrated through a piece of steel quite as quickly as a drill of the best quality of steel tempered in the ordinary manner would have done, and a circular saw tempered by electricity severed bars of iron with a remarkable degree of ease. With shears of electric steel a bar of steel one and three-eighths inches wide and three-fourths of an inch thick was cut in two in a cold state, the same operation being repeated five times on the same bar, with no alteration whatever observable on the edge of the shears; and a simple table knife, tempered by this new process, cut eleven times in succession a piece of iron wire one and a half millimetres thick as easily as if it had been a piece of string. All the explanation of this process consists in the statement that the tools are dipped, after being heated, into a conducting bath traversed by electricity.

OUTAGES OF CITY ELECTRIC LAMPS.

IN the last annual report of the City Electrician of Cincinnati, considerable attention was given to the question of the outages of city electric lights. The difficulty in the case of outages seems to lie in the difference between those reported by the police department and those acknowledged by the illuminating company having the contract for the city lighting. His report states that "it is not customary to deduct lamps that are out less than an hour, although entire circuits have been out for from fifteen to forty minutes for which no deductions were made."

"I do not think (although it is a legal point) that it was ever intended or contemplated in the contract that the 'hour clause' should refer to whole circuits or districts, and would recommend that a system be devised so that when whole circuits are out for less than one hour the time of outage could be reported and deducted, and suggest that a man be placed at the electric light station to keep tab on circuits only, noting and reporting the time said circuits were out."

The total number of outages reported to the electrical department from all sources was 35,238 hours and 44 minutes, representing a money value of $775.40, out of which the Cincinnati Edison Electric Company acknowledged only 10,924 hours and 33 minutes, or $240.35. The money lost to the city, therefore, by the difference in these reports amounted to $535.05.

THRESHING BY ELECTRICITY.

A special dispatch from Avondale, Pa., of August 12, says: Henry Palmer and some other farmers in this section are using the electric current to furnish power to run their threshing machines. Many barns have been destroyed by sparks from the steam engines, and it is thought by means of electricity this danger will be avoided.

ELECTRICAL MARINE EFFECTS AT HALIFAX, N. S.

At the Halifax, N. S., Carnival just closed one of the principal attractions was the electrical illuminations of the warships and the illuminated procession, in the harbor, of steamers, yachts and boats. The flagship "Crescent" was decorated from the water line to the trucks with incandescent lamps indicating plainly the shape of the hull as well as the masts, yards and funnels, even more minutely than was done on H. M. S. "Blake" when she was in New York. The other English and French war-ships and the cable ship "Mackay Bennett' made wonderful displays with their search lights and blue fire. The illuminated procession had a very pleasing effect, the steamers and yachts being decorated with all sorts of lights. But what was pronounced the handsomest exhibit of all was the steamer "Annie," on which had been placed a special engine and dynamo with strings of incandescent lamps covered with fancy shades and Wheeler reflectors. This installation was the work of John Starr, Son & Co., Ltd., the electrical firm of Halifax, who had a party of friends on board. Among the visitors thus entertained was Mr. S. A. Chase, of the Western Electric Company of New York.

RECENT INSTALLATIONS OF THE BALL ENGINE CO.

We give below a long and encouraging list of recent installations made by the Ball Engine Company of Erie, Pa:

Ohio State Reformatory, Mansfield, O., two 150 horse-power engines direct connected to Card dynamos; Warner Lock Company, Lyons, Iowa, one 60 horse-power engine; Aberdeen Electric Light Company, Aberdeen, Miss., one 100 horse-power engine; Baltimore Sugar Refining Company, Baltimore, Md., one 40 horse-power engine; Lynchburg Cotton Mills, Lynchburg, Va., one 60 horse-power engine; Carpentersville, Elgin and Aurora Railway Company, Elgin, Ill., one 400 horse-power vertical compound condensing engine, direct connected to General Electric Company generator; Electric Light Plant, Ovid, N. Y., one 70 horse-power compound engine and steam plant, complete; one 35 horse-power engine for Mexico; Edison Electric Illuminating Company, Baltimore, Md., one 300 horse-power cross compound engine; McIntosh, Hemphill & Company, Pittsburg, Pa., one 100 horse-power engine, direct connected to Westinghouse generator; Crocker-Wheeler Electric Company for Versailles, Pa., one 150 horse-power engine; Western Electric Company, Janesville, Wis., one 40 horse-power engine; Danville Street Car Company, Danville, Va., one 150 horse-power engine; Mohawk Building, Cleveland, O., three 50 horse-power engines, direct connected to Walker dynamos; Harper Hospital, Detroit, Mich., two 70 horse-power engines, direct connected to General Electric dynamos; Booth Packing Co., Baltimore, Md., one 80 horse-power engine; Mt. Washington Electric Light and Power Company, Mt. Washington, Md., one 100 horse-power engine; Lehigh Valley Coal Company, Wilkesbarre, Pa., one 250 horse-power tandem compound; G. & O. Braniff & Company, City of Mexico, one 80 horse-power and one 30 horse-power engine; Tremont Building, Boston, Mass., one 100 horse-power and one 50 horse-power, direct connected to General Electric dynamos.

GENERAL ELECTRIC X-RAY APPARATUS.

Investigators and others practically interested in X-ray work will without doubt be greatly interested in noting the appearance of a large and responsible concern as manufacturers of all kinds of X-ray apparatus. As will be seen in our advertising columns, the Edison Decorative and Miniature Lamp Department (General Electric Company, Harrison, N. J.), is in the field with an entire line of X-ray apparatus of all kinds.

We hope to be able to present to our readers shortly some further description of the apparatus which is now being made and extensively sold by the above concern.

WATERTOWN ENGINES.

W. H. Baker & Co., the well-known chocolate manufacturers, have just completed the equipment of a new plant at Annadale, Dutchess County, New York. The contract for steam plant, including engines, boilers, pumps, heaters, etc., has been awarded to the Watertown Steam Engine Company. The plant to be turned over erected complete and in full running order.

The Watertown Steam Engine Company present the following list of sales during July: One 13&22 x 14 compound condensing engine, direct connected to Westinghouse generator, for Ohio State University, Columbus; one 9 x 10 high-speed automatic for Maggie Mitchell Apartment House, N, Y.; one 12 x 12 H. S. direct connected to Eddy generator for Cameron Apartment House, New York; one 10 x 12 belted engine for Rome Custodial Asylum, Rome, N. Y.; three 9&16 x 14 vertical compound condensing engines, direct connected to Eddy generator, for Pope Bicycle Manufacturing Company, Hartford, Conn.; one 14 x 14 single-cylinder direct connected to General Electric dynamo, for Hotel Stafford, Baltimore, Md.; one 15 x 14 single-cylinder direct connected to Siemens & Halske generator, for Roosevelt Hospital, New York; two 15 x 14 direct connected to Walker generators, for Windsor Hotel, New York; one 13 x 14 and one 10 x 12 direct connected to Siemens & Halske generators for the Chemical Building, St. Louis. Also remodeling the steam plant of the New York State Insane Asylum, at Utica, N. Y., including battery of six 125 horse-power boilers.

RECENT ENGINEERING WORK.

The above is the title of a handsomely-illustrated pamphlet published by Ford & Bacon, engineers, Mail and Express building, New York, in which two of their street railway systems are described in great detail. This concern take entire charge of the engineering details of street railway and other systems, attending to the details of construction, including all civil, mechanical and electrical engineering connected with the work. They furnish all surveyors, draughtsmen, inspectors and clerical force needed for the work, together with all the engineering supplies used.

The descriptions given of the Orleans Railroad system and the Bergen County Traction Company's system which were built by Ford and Bacon, shows their work to be of the highest character.

SELF-LIGHTING OIL LAMPS.

The Empire Self-Lighting Oil Lamp Company, 766 Broadway, N. Y., held an "opening" recently, at which they had on hand a large and varied assortment of lamps all equipped with their electrical self-lighting attachments.

A small, dry electric battery, hidden in the base of the lamp, does the lighting in the most convenient and perfect manner. The arrangement is simple, reliable and safe. It will light the lamp once or twice a day during six to nine months without renewal, and it then costs but sixty cents to replace the battery.

It is not liable to get out of order; a child can light the lamp without danger, and there are no complications whatever. The oil chamber may be removed and the lamp taken apart for cleaning as easily as in the case of a lamp not provided with the attachment.

ELECTRIC CAR HEATERS.

The American Electric Heating Corporation, of Boston, Mass., have issued a new catalogue for 1896-7, describing their electric heaters. These are arranged so that all the heaters in a car may be used at the same time, with three different degrees of heat. The arrangement of the heating coils is such that the principal radiation is from the front surface, i. e., towards the center of the car when placed along the sides, a more efficient method than when both sides of the case may become equally heated. When three divisions of heat only are required it can be accomplished with a pair of single switches of their latest form, or if preferred their combination switch may be used, although the latter is most desirable where more than three variations of heat supply is required.

This concern is exclusively engaged in producing electric heaters, and with its corps of expert electrical engineers there is every reason why the best results of electric heating should be obtained with their product.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY have been somewhat delayed in getting in their stock of "Electra" high-grade Nuernberg carbons, but have finally received their first carload, and are now ready to talk imported carbons to the Western trade. They will carry the largest stock of imported carbons in the West, and as exclusive Western representatives of the manufacturers, are prepared to make the right kind of prices.

J. HOLT GATES has been appointed Western sales agent of the Walker Company, manufacturers of street railway apparatus, of Cleveland, O. Mr. Gates is also Western sales agent of the C. & C. Electric Company, New York, and in his salesroom at 311 Dearborn street, Chicago, under Manhattan Building, he carries a full line of dynamos and motors, enabling him to make prompt shipments. Now, that he has the Walker and C. & C. companies' agencies, almost any requirement in lighting, power and railway machinery can be filled immediately.

WHAT TWO ORDINARY MOTORS WILL HAUL.

The limitations of electric railway motors are occasionally hard to discover. They sometimes submit to extraordinary overload and perform their duty without accident or even hesitation. An instance of this occurred recently at Madison, Wis., where, according to Mr. F. W. Oakley, the receiver of the Madison City Railroad Company, one of the General Electric Company's double General Electric 800 motor equipments, was overloaded to the extent shown in the illustration. The load consisted of the motor car and four trailers, containing all told not less than 500 persons. With this load a speed of seven miles an hour was maintained, the motor car and train running up the heaviest grades without difficulty. This, we believe, is about the best record made by an ordinary car equipment and speaks well for the sturdiness of the motor and its ability to stand up against abnormal strain.

A FATAL FIRE AT THE FACTORY OF THE A. K. WARREN ELECTRIC CO.

On Tuesday afternoon, August 11, the large factory and repair shops of the A. K. Warren Electric Company, in the extensive building at 465 Greenwich street, New York City, were visited by fire. The building is six stories, of brick, and the fire appears to have broken out in the basement, though its origin is unknown. The bookkeeping offices of the firm were on the ground floor, and the staff there barely had time to get out, so quick was the rush of the flames. A young man named Teer showed great courage in staying long enough to get the books and papers of the firm into the safe. About 60 or 70 men were employed by the firm on the premises, in addition to their outside staff, and in trying to give warning to the hands, the foreman, William Gray, who could easily have escaped, lost his life. He delayed trying to make his escape until the last, and then sought to ascend by the elevator. By the time he had reached the sixth floor the fire was so close behind him that he had not time to try to reach the roof, where he would have been safe, and ran to the fire escape at the front window. The flames followed him, making escape impossible. William Caulfield and Charles Coones, who had reached the roof, looked over the edge and saw Gray on the fire escape below, penned in by the flames.

An electric wire ran across the roof. This they cut in two, and lowering one end to Gray told him to tie it around his waist and they would try to pull him up to the roof.

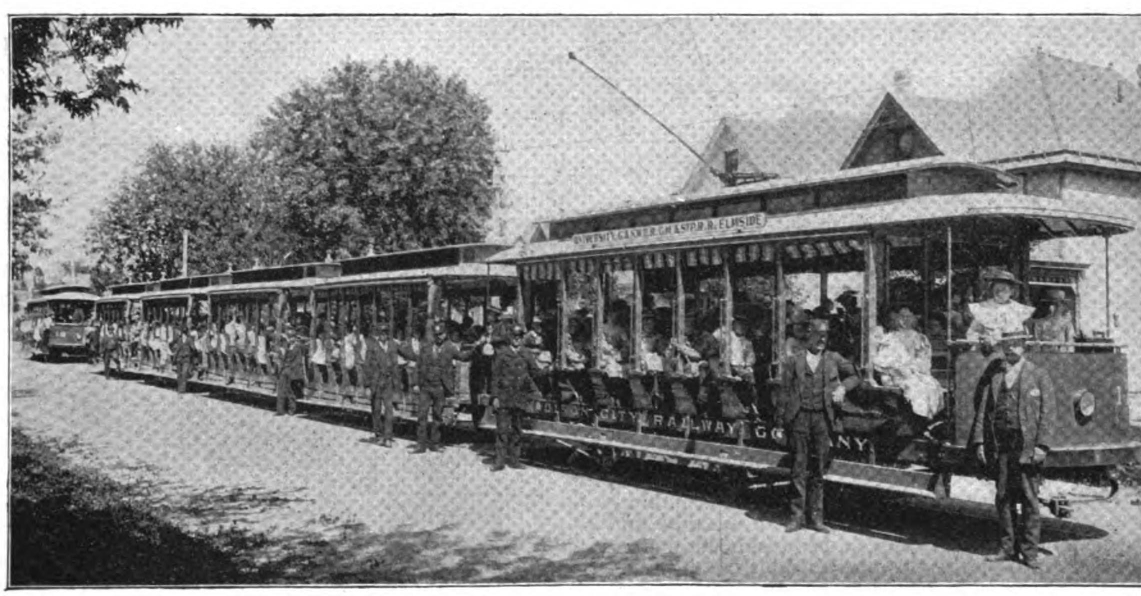
Gray succeeded in passing the wire around his waist, but the flames were so close upon him and the smoke so thick and choking that he could do no more. He sank upon the fire escape, while in only a few moments more he might have been in safety, and there met his frightful death.

He was burned slowly to death and for nearly five hours his charred body, the limbs contorted, showing the frightful agony he had endured, could be seen from the street, the firemen being unable to reach the body until the fire was almost extinguished.

Felix Haas and John Muller, employees of the firm, were also burnt to death; while John Cummings, T. Sharkey, J. W. Teer and N. Stavni were all severely burned. Messrs. Warren and Steers, members of the firm, were lucky enough to have gone out to lunch at the time—about half past two—the pressure of business having detained them at work until that hour. They were insured.

William Gray was once a soldier in the English army and had medals for campaigns in South Africa and Afghanistan. He lost his life through anxiety for his fellow workmen. He leaves a widow and three children.

A. K. Warren & Company inform us that they have taken temporary offices at 20 Desbrosses street, and have already started again with a full force. They are now filling all orders and taking care of their large list of customers. They have the fullest sympathy, in their disaster, of a wide circle of friends.



One Motor Car Hauling 500 Passengers, Madison, Wis.

WESTERN NOTES.

KOHLER BROS, the Monadnock, Chicago, report that they are making good sales of the electrical apparatus manufactured by the Gibbs Electric Company, Milwaukee, for whom they are general agents, and that the factory is working on full time so as to enable them to ship promptly.

ROTH BROS. & CO., 30-34 Market street, Chicago, are still keeping quite busy in getting out their orders, and, although the fan motor business is now nearly at an end, they are looking forward to a good winter trade in dynamos and motors and are in a position to fully equip moderately sized storage battery or steam lighting plants. This young and enterprising concern have not only shipped goods all over the United States, but have also received some very nice orders from foreign countries.

THE ELECTRIC APPLIANCE COMPANY'S complimentary duplicate order book advertising scheme has proven to be a big success and the books are much appreciated by their customers. The Electric Appliance Company still have a number of books left which will be sent free on application.

THE STANDARD HEAT CONTROLLER COMPANY, 211 First National Bank Building, Chicago, feel so much encouraged by the expressions of satisfaction which they have received from those whom they have supplied with their heat regulating apparatus, that they are about to push hard for a large business in the coming fall and winter. As a preliminary step in that direction they have recently published a very handsome illustrated and descriptive catalogue of their regulators which they claim to be up to date in every respect. At the end of the book are shown some of the testimonial letters received by this concern, as well as the names of several people whose dwellings have been equipped.

THE ACME ELECTRIC LAMP COMPANY, 1659 Broadway, New York, are a young concern in the trade, with a new dry battery suitable for bicycle, road wagon and carriage lamps, electric bells, telephones, electric lights for launches and physicians' batteries, etc.

NEW "G. I." ARC LAMPS.

The General Incandescent Arc Light Company are putting out some handsome designs of their long life direct current arc lamps. These lamps are very attractive and ornamental in appearance. The feeding mechanism is simple and reliable. No springs or gear wheels are used. The regulation is close and the adjustment cannot change. Trimming can be done easily and every part can be removed without disturbing the others.

They burn singly on 100 to 125 volt direct current circuits. One pair of carbons lasts 150 hours.

SILEX INSULATION.

The Silex Insulation Company, 39 and 41 Cortland street, New York City, invite the electrical public who are interested in the subject of insulation to a demonstration at their office of the insulating properties of Silex, made under the patented process of this company.

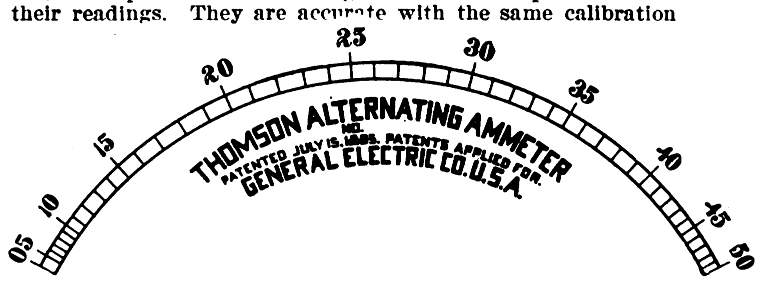
They have also prepared a pamphlet under the title of "A Day with Silex," in which the nature of this substance is described and many of the uses to which it may be put are enumerated. The company state that they are prepared to prove that the problems of perfect insulation and long distance transmission of electrical energy can be solved by their preparation of Silex, and they would be pleased to have their claims investigated.

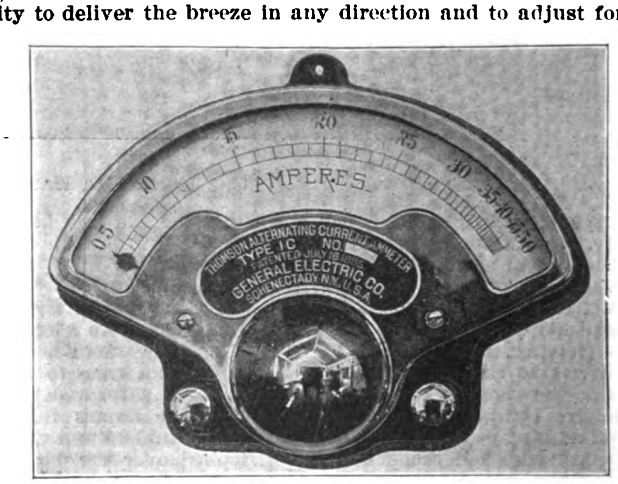
J. D. MILLER & CO.

Mr. John D. Miller and Mr. Edwin H. Ludeman, under the style of J. D. Miller & Co., have issued a notice that they have severed their connection with the Pierce & Miller Engineering Company, and that they will now do business in partnership as above. They will endeavor to meet all requirements in their line of complete power plants, engines, boilers, general machinery and contractors' supplies. They are ready to furnish plans, specifications and estimates. Their offices are in the Taylor Building, Cortlandt street, New York City.

THOMSON ALTERNATING CURRENT AMMETER.

The inclined coil type of measuring instrument developed by Professor Thomson, with the portable forms of which we are familiar, has been adapted for use on switchboards, and a complete series of these instruments is now being manufactured by the General Electric Company. With the accuracy and durability of the portable appliances, they combine, it is stated, the long scale and general mechanical character requisite in modern switchboard practice. The instruments are free from parts liable to change and thus are permanent in their readings. They are accurate with the same calibration





THOMSON ALTERNATING CURRENT AMMETER.

for all commercial frequencies. Each instrument is constructed for either back or front connection, is fitted with a light nickel cover and binding posts and a black enamelled metal base. The ammeters read from 0 to 3½, 10, 25, 35, 50, 75, 100, 150 and 200 amperes; the volt meters from 0 to 75, 150 and 650 volts.

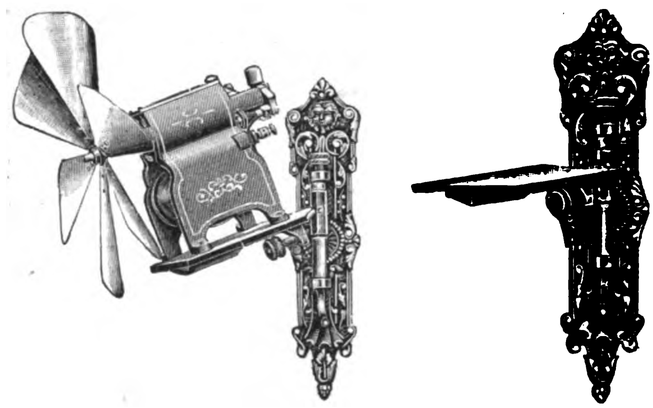
THE DOW PORTABLE ELECTRIC ASSISTANT COMPANY has been organized at Westbrook, Me., to deal in electrical apparatus. It has a capital stock of $100,000. The officers are: G. W. Wheeler, president; W. E. Dow, treasurer, both of Braintree, Mass.

THE AMERICAN ELECTRICAL WORKS CLAMBAKE.

Invitations have been issued by Mr. Eugene F. Phillips for the Eighteenth Rhode Island Clam Dinner given by the American Electrical Works to the electrical fraternity. The date is Saturday, August 22, and the place is the Pomham Club, Providence. A delightful day is confidently expected by everybody.

THE FULLER FAN MOTOR OF THE NORTH AMERICAN ELECTRIC CO.

We illustrate herewith one of the ingenious novelties that the fan motor art has given birth to, and one for which there should be an abundant welcome from the public and the trade. The devices are the patented invention of Mr. John E. Fuller, and are introduced by the North American Electric Company, of 181 William street, New York City. As will be seen, a metal bracket provides for that adjustment of the motor to



FIGS. 1 AND 2.—FULLER ADJUSTABLE FAN MOTOR OUTFIT.

varying conditions that is so essential to securing the greatest comfort, economy and efficiency from the outfit.

There is a substantial and ornamental brass plate which supports a table at right angles to itself on which the motor is placed. A thumb-screw permits tilting the motor so as to carry the current of air in any direction. The plate supporting the motor is hinged to a vertical post which also allows lateral motion. The plate screwed against the wall is elaborately finished. The tables for these brackets are made of different sizes to suit the various fan motors on the market.

The North American Electric Company sell a well finished set of fan motors of different sizes, both incandescent and battery, to suit the consumer's necessities. It is obvious that the ability to deliver the breeze in any direction and to adjust for any new set of conditions is a great advantage and boon; and while many attempts have been made to reach this result, it will be readily admitted that Mr. Fuller has been successful.

THE SOUTHERN ELECTRICAL CONSTRUCTION AND SUPPLY COMPANY, of Norfolk, Va., has made an assignment, Leon Judson, trustee. The liabilities are upwards of $14,000 and include Western Electric Company, $658, and Interior Conduit and Insulation Company, $973.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. AUGUST 26, 1896. No. 434.

MISCELLANEOUS.

ALTERNATING CURRENT MACHINERY AT THE BUDAPEST MILLENNIUM EXHIBITON.—V.

BY ALFRED O. DUBSKY.

A VERY curious experiment shown at the exhibition illustrates the extent to which a careful insulation may be strained. Messrs. Ganz exhibit a three-phase motor of 1 horsepower, working completely submerged in water. There is a large glass vessel full of water, and an ordinary three-phase motor is dipped into it, in such a way that the water circulates freely about it. The air gap is now in reality a "water gap!" It is wound for the regular tension of 300 volts, a tension with which two bare copper conductors connected to the generator terminals melt when under water. The machine works several hours under water every day, without incurring the slightest injury. The rotor has its winding short circuited, and the connections are covered by a mixture of paraffin, tar, etc. The stator is wound in an ordinary way, with a double-covered cotton wire; this is afterwards insulated carefully with a special paste, used for insulating all the Ganz machines.

Another three-phase motor of the same size (1 horse-power) is put upon four spiral springs about 30 cm. above the floor, in order to show the absence of any irregular movement or vibration. While revolving no oscillations of the spring are visible, for the rotor is well balanced. It is, of course, only a common demonstration of a well-known fact, that carefully balanced electric motors never need such solid foundations as are prescribed by steam engine practice.

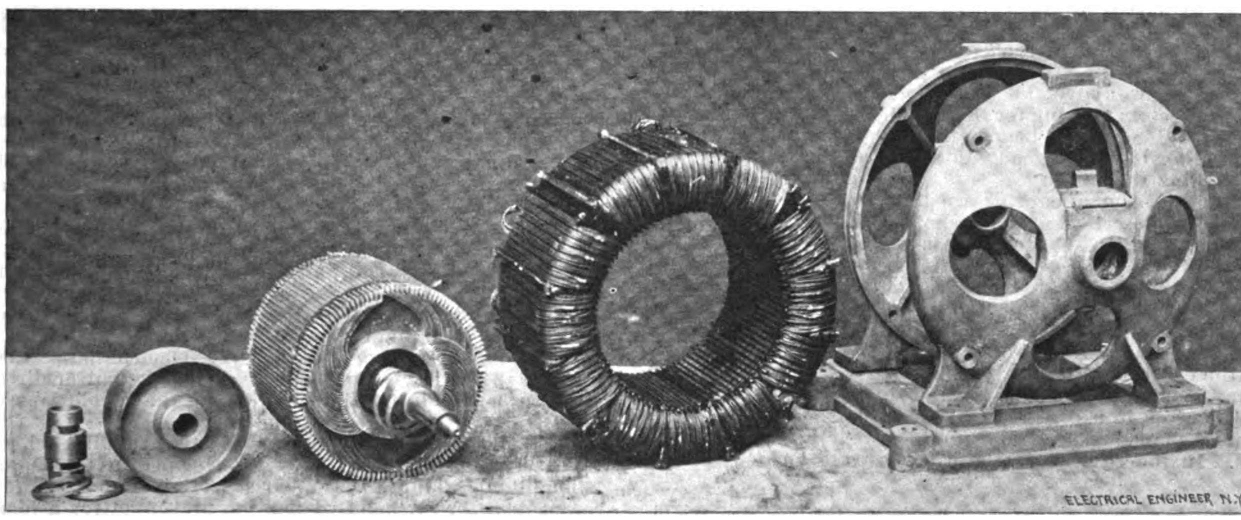


FIG. 22.—PARTS OF THREE-PHASE, 3 H.-P. MOTOR.

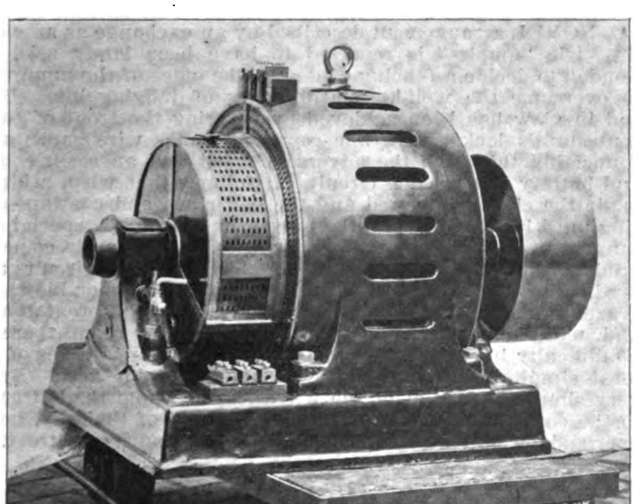


FIG. 23.—NEW TYPE 16 H.-P. THREE-PHASE MOTOR.

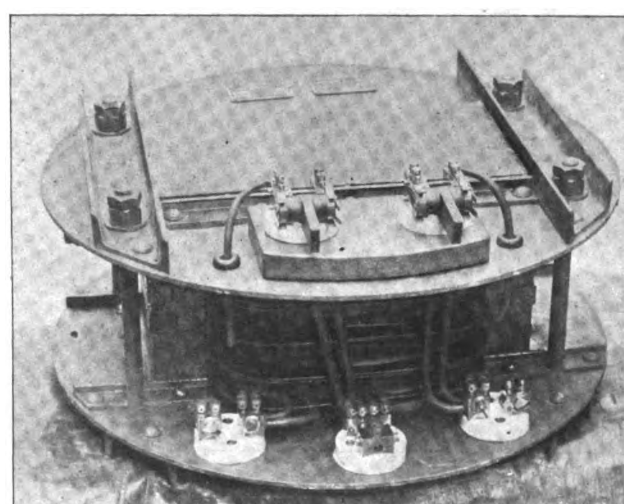


FIG. 24.—NEW GANZ SINGLE-PHASE TRANSFORMER.

Fig. 22 shows clearly the construction and details of a 3 horse-power three-phase motor (4 poles, 1,200 revolutions per minute). The winding of the inducing part is a ring winding, therefore the iron plates are pressed together in a bronze case.

The bearing shields on both sides are made of cast-iron and are held together by long iron bolts traversing the whole width of the motor. The single parts of such a motor are snown here separately. This general type is used for motors up to 8 horse-power in capacity, while a large 16 horse-power motor is illustrated in Fig. 23. The parts of the motor shown in Fig. 23 are made of cast-iron. The motor has a drum winding, which is always advantageous for motors of a large size. Here we have the possibility of using copper bars for the winding, both of the stator and of the rotor, and this a cheaper construction than with wire. Moreover, the magnetic dispersion is also less with such an arrangement.

I may here mention a very little-known method of determinating the curve of the "slip" in testing these motors. This method can be used for alternating current motors in general and is very simple. An arc lamp is put before the pulley of the motor and this lamp is fed by the same current we send into the motor. I should say that this lamp can be of a very primitive construction without any complicated machinery. There is fixed on the pulley a round plate of thick black paper with a line or cross drawn in white upon it. If the motor turns while the lamp is burning, we shall see that the line or cross will revolve with a greater or smaller speed, as the motor is more or less loaded. It is very easy to count the number of these revolutions; this number is directly the slip of the revolving magnetic field in comparison with the field revolutions corresponding to the number of periods of the generator.

The switchboard which controls the single-phase lighting generators and the three-phase central station machines, is situated in the middle of the great machinery hall and located on iron beams about 8 feet above the floor in order to bring it in full view above all the electrical machines. The metallic rheostats serving for the parallel coupling are mounted just below the horizontal beams, they are surrounded by a network, in order to assure good ventilation and prevent anything from touching them.

The high tension apparatus used on this switchboard has been already described in a foregoing chapter. I shall now make some mention of the low tension switches used in the power distribution. Most of these switches have fuses put directly upon them. The switches make a very quick break, as it is attained by the intermediate use of a spring, the handle serving only to give the first impulse.

There is still a great deal of alternating current apparatus in use at the exhibition which remains to be described. The newest Ganz single-phase transformer (5 kilowatts), as shown in Fig. 24, has its iron core made of two parts. Each part consists of E-shaped iron sheets, pressed together by the end-shields. In the cavities of the iron core are located the primary and secondary windings; they are thoroughly insulated, wherefore a short circuit to earth or between the two windings has never happened in regular work. The above-mentioned end-shields are made from thick iron plates stiffened by the use of iron ribs. The shields are round and have a diameter so large that the transformer can be rolled on the floor, which circumstance greatly facilitates their transportation. One of the shields carries the primary terminals, the other one carries three secondary terminals (the middle terminal being for 50 volts), each being supplied with its separate fuse. The primary fuses can be exchanged even during the regular work, as they are provided with long ebonite handles. These same high-tension fuses are used in the cable junction boxes (Fig. 25) which are employed in the primary network of the exhibition.

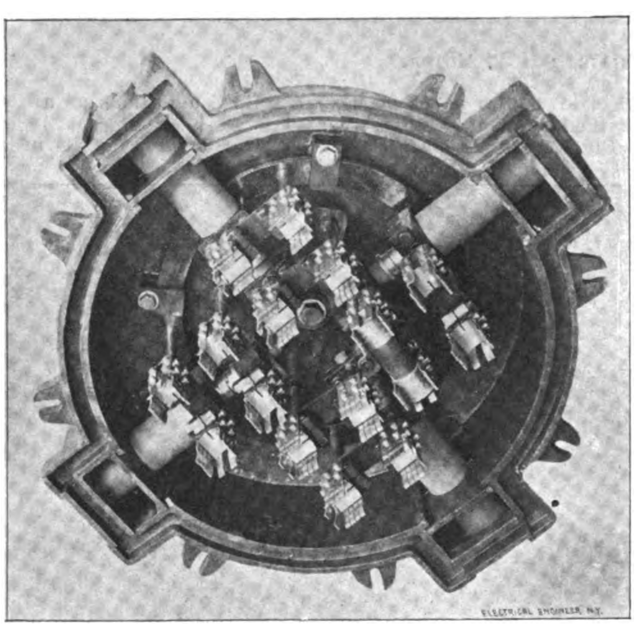


Fig. 25.—Cable Junction Box.

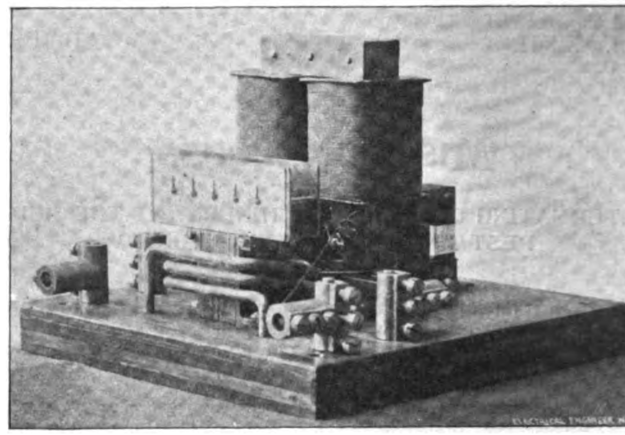


Fig. 26.—Blathy Recording Wattmeter.

In this way the network can be switched without disturbing the regular work of the central station.

The recording wattmeter serving to control the use of electric power by the several consumers, is shown in Fig. 26, and is the apparatus patented by Mr. O. T. Bláthy. It consists of an aluminum disc which is put into rotation by the torque produced by the action of two coils. The main current flows through one of these coils, and the other coil is a shunt, having large self-induction. As the magnetic fields induced by these windings in the respective iron cores, have a lag of about 90 degrees, the aluminum disc will revolve and the number of its revolutions are proportional to the electric power flowing through the mains. A clockwork, giving the power directly in kilowatt hours, is put into motion by the revolutions of the disc.

These descriptions show that the electrical exhibit (chiefly the alternating current part), is well developed at the Hungarian Millennium Exhibition. Industrial work in Hungary is of very recent growth, for political reasons prevented for a long time any activity in this direction. Therefore it is a sign of great vitality of the nation, if, notwithstanding all difficulties, it has produced already such various, new and interesting manufactures during its relatively short experience.

AN ELECTRIC UMPIRE.

A NOVEL arrangement described by an exchange as an electric "umpire" is reported to have been lately used in London to decide a fencing contest. The office of the umpire is to overcome the well-known difficulty of judging hits. The end in view has been achieved by covering the front of each contestant's jacket with fine copper or brass wire gauze and connecting this with the adversary's foil and an electric bell and battery in the same circuit. It follows that when a hit is made the circuit is closed and the bell rings and continues to ring until it is stopped by the person in charge. A special arrangement in each foil-handle provides that only a direct point produces a ring. Two entirely electrically distinct circuits are used, each including a bell, foil and jacket; flicks or blows or grazes produce no result. The bells being of different tones, and, moreover, placed on opposite sides of the room, there is no difficulty in deciding who has scored a hit, or in cases of almost simultaneous hits who delivered the point first. By a very simple arrangement the wires passing from the batteries to the combatants' collars are kept well out of the way, however sudden may be their movements of advance or retreat.

WORLD'S FAIR MEDALS.

The Electrical Engineer is glad to announce that it has at last received its World's Fair Medal, but it does not quite understand why the date of the discovery of the New World appears on the medal, on one side, in Roman characters as MDCCCXCII. The engraver responsible for this funny blunder (?) appears to be C. E. Barber, whose name is very conspicuously cut into the medal.

ALTERNATE CURRENT TRANSFORMERS.—II.

BY J. A. FLEMING, F. R. S.

GENERALLY speaking, in a machine like the Mordey alternator with a very small armature reaction, there is considerable change in the form of the electromotive force curve with the nature and amount of the load on the alternator, but in the case of a machine like the Thomson-Houston or Westinghouse alternator with a large armature reaction there is a very considerable change in the form of the electromotive force which changes in the amount and nature of the load. In the above cases the form of the electromotive force curves have been set out graphically in what are called wave diagrams, in which the

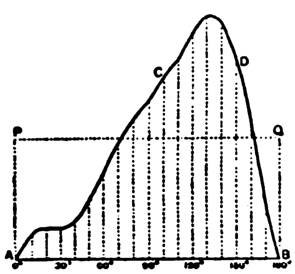


FIG. 16.

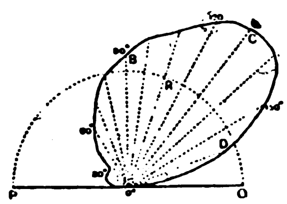


FIG. 17.

horizontal ordinates represent time, and the vertical ordinates represent the magnitude of the quantity which is varying, whether electromotive force or current. For some purposes, this method is not so convenient as that of setting out the curves in the form of polar diagrams.

The differences between these two methods—graphically delineated a periodic quantity—are shown in Figs. 16 and 17. In Fig. 16, part of the curve of the electromotive force of a Thomson-Houston alternator on an inductive load is shown. In Fig. 17 the same quantity is delineated in a polar curve. Instead of drawing vertical ordinates at equal distances to represent the instantaneous values of electromotive force, radii are drawn from a point, O, at equal angular intervals, the magnitudes of which are respectively proportional to the instantaneous values of the periodic quantity. A curve, B, C, D, is thus obtained, which is called a polar curve. It has this interesting property, that if we find the area of the polar curve, and describe a semi-circle on a line, P, Q, passing through the pole, O, the area of which is equal to the area included by the polar curve, B, C, D, it can easily be shown that the radius of this semi-circle represents the square root of the mean of the squares of all the radii of the polar curve. This quantity is now generally called the R.M.S. value, or the root-mean-square value of the periodic quantity. By some writers it has been called the effective or virtual value. Ordinary alternating current ammeters and voltmeters give, as is well known, the R.M.S. value of the periodic quantity they are measuring.

Returning to Fig. 16, if we construct a rectangle, A, P, Q, B, equal in area to the area included by the wave curve, A, C, D, B, then it is easily seen that the height of this rectangle, namely, A, P, represents the true mean value of the periodic quantity represented by the ordinates of the wave curve. In the case of any periodic quantity, such as a periodic electromotive force or current graphically delineated it is found convenient to have a term to denote the ratio between the true mean value of the curve ordinate and the root-mean-square value, and this is called the form factor of the curve.[1] Having thus seen the manner in which we can experimentally determine the form of an electromotive force or current curve, which represents the different instantaneous values of a periodic electromotive force or current, we can now proceed to discuss the manner in which these methods have been applied in the study of the alternate current transformer. Let us first suppose that the transformer to be studied is a constant potential transformer, having two windings, a primary and a secondary coil, both wound round an iron core forming a completely closed iron magnetic circuit. Let the primary coil be joined up through a non-inductive resistance, R^1, as shown in Fig. 2, with a circuit of constant potentials, and let the contact breaker above described, denoted by C, and the electrostatic voltmeter, V, be applied to determine the form of the current curve flowing into the primary coil, P, of the transformer. In order to delineate the form of the curve of primary potential difference, it is necessary to put across the primary terminals of the transformer a non-inductive resistance, R^2, which is divided in a definite ratio, so that by measuring a fraction, say, 1-20th of the whole difference of potentials between the terminals of the primary circuit of the transformer, we can determine the total potential difference. After much experimenting, I succeeded in devising a form of resistance which is now before you, and which is very convenient for this purpose. It is called a resistance cage. It consists, as you see, of a series of brass rods held in a wooden frame, each rod carrying a pair of porcelain heads, with porcelain pins on them (see Fig. 18), and these porcelain heads are kept pressed apart by a spring. Over the pins on these porcelain heads is wound, in zig-zag fashion, a platinoid wire, so as to form a perfectly ventilated non-inductive resistance. Each of these resistances is adapted for withstanding 100 volts pressure, and carrying ½ or 1 ampere, and a series of 20 of these resistances can be put across the primary terminals of a transformer, and will withstand the pressure of 100 volts for as long as necessary. By measuring the fall of potential and delineating the periodic value of the difference of potential between the terminals of one cage, which forms one of a series of 20, we can delineate the whole difference of potential between the terminals of a transformer. In this way we can take curves of primary current and primary electromotive force on the high tension side of a transformer. In the next place we can perform the same operation on the secondary side of the transformer, and obtain the secondary terminal potential curve, and also, if the transformer is sending a secondary current, the secondary current curve for that transformer. When these experiments are carried out for any good closed circuit transformer, and delineated in the form of a series of curves set in their proper relative position, which it is convenient to call a transformer diagram, we find the following results: In the first place, the curve of secondary potential difference is always an exact copy to a reduced scale of the curve of primary potential difference, and it is very nearly exactly in opposition to it in phase. This is shown in Fig. 19 and Fig. 20. Fig. 19 gives us the curves of primary and secondary electromotive force of a Thomson-Houston transformer taken off a Mordey alternator.

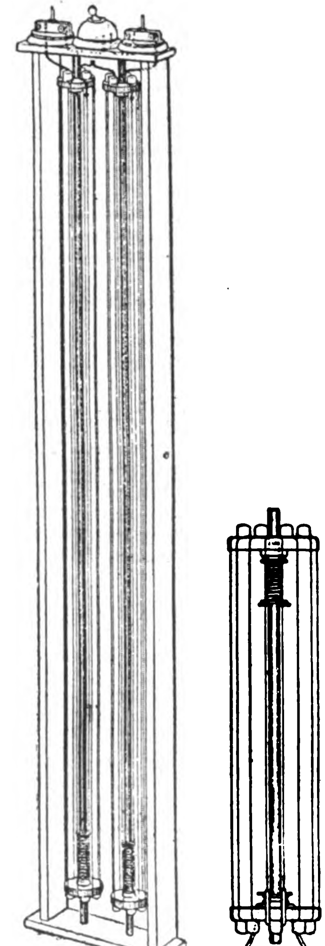


FIG. 18.—NON-INDUCTIVE RESISTANCES.

If the transformer is taken at no load, and if the curves of primary and secondary electromotive force are drawn to such scale as to their maximum ordinates equal to one another, and if they are drawn on the same side of the axis, then it is found

[1] For further information on this point see "The Alternate Current Transformer," Fleming, Vol. I. (new edition), p. 583.

that at no load the transformer curves exactly overlap one another. If the transformer is partly or wholly loaded up on its secondary side, so as to cause it to send a secondary current, then the secondary electromotive force is a little advanced in phase over the curve of primary electromotive force, as shown in the curves. Fig. 20 shows the same thing for the same transformer taken off a Thomson-Houston alternator. Hence we see that the closed circuit transformer acts like an electrical pantograph: it copies electrical potential difference, and the curve of secondary potential difference is always a nearly exact copy of the curve of primary potential difference;

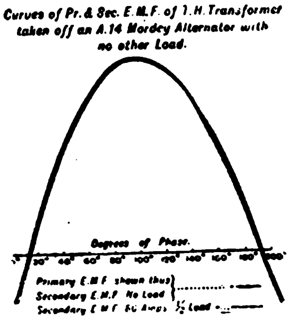


FIG. 19.

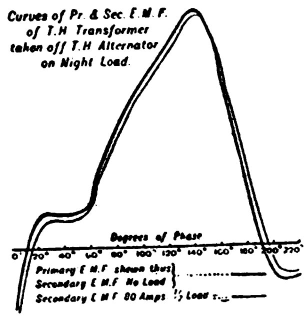


FIG. 20.

but to a reduced scale depending on what is called the transformation ratio of the transformer. On delineating the curve of primary current of the transformer when the transformer is taken at no load, as shown in Fig. 21, we see that the curve of primary current, when the secondary circuit is open, differs in phase from the curve of primary potential difference. It lags behind it, and the same thing is shown by reference to Fig. 14, where the curve of primary electromotive force for another transformer taken off the same alternator is given. It will be seen that even if the same alternator is employed for the test, the curve of primary current at no load is not the same in form in the case of all transformers. The form of this primary current curve is governed by the nature of the iron employed in the core. We then notice that even in cases where the primary electromotive force curve is more or less approximately a sine curve or simple periodic curve, the curve of primary current is always more irregular. Having in this manner delineated the curves of primary current, primary electromotive force and secondary current, we have then to determine the manner in which the induction in the core is varying with relation to these other varying quantities. We can draw out a curve of induction from the curve of a secondary electromotive force in the following manner.

Since the secondary electromotive force of the transformer at any instant is measured by the rate at which the magnetic induction linked with the secondary circuit is varying, we can construct the induction curve in the following way, as shown in Fig. 22. The curve marked E.M.F. represents a transformer secondary electromotive force curve. The whole area of the curve is divided into two equal parts by a vertical line. Starting from this vertical line, half of the curve, say, the right-hand half, is divided up into narrow strips of equal area, which are represented by the cross-hatched slips. The areas of these very narrow slips are then taken with the planimeter,

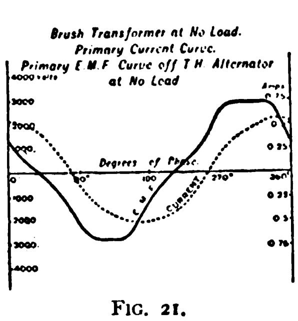


FIG. 21.

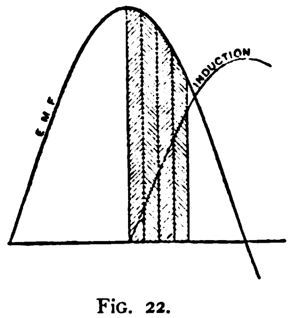


FIG. 22.

and we set off, starting from the middle point of the time axis, the curve of induction by the following method: Starting from the middle point of the time line, we set off on the right-hand side of the first slip an ordinate, which represents to some suitable scale the area of slip No. 1. On the right hand bounding line of slip No. 2 we then set off an ordinate equal to the same scale of the total areas of slips Nos. 1 and 2 together. On the right hand bounding line of the third slip we then in the same way set off an ordinate representing the total area of the first three slips, and so on. In that way we obtain points on a curve which represents what is called the time integral of the electromotive force curve, and this is, therefore, the proper representation for the induction curve. In order to determine the scale to which this induction curve is drawn, we must know what is the value of the maximum ordinate of the induction curve. This can be done in the following manner: If B represents the induction in the core, S the cross-section of the core, N_2 the number of turns of the secondary circuit, n the frequency of the alternating current, and f the form factor of the secondary circuit curve, then it can be shown that the root-mean-square value of the secondary electromotive force is equal to $4\ f.n.N_2\ S\ B$; and hence, since the root-mean-square value of the secondary electromotive force is immediately known from the delineated curve, and also its form factor, we can easily calculate the value of B, that is, of the induction.* That is to say, in this manner not only can we thus delineate the curves of current electromotive force, but also the induction, and represent them graphically on the same diagram. In Fig. 23 are shown the curves of primary electromotive force, primary current, and induction for a Ganz transformer taken at no load. The curve of induction can be determined in the above-described manner, not only from the curve of secondary electromotive force, but also from the curve of primary electromotive force. If this is done, it is found that two curves of induction so obtained do not exactly coincide. The reason for this is the magnetic leakage of the transformer. This last term is best defined by saying that when the transformer is at work, and sending a secondary current, the whole of the magnetic induction which is linked with the primary circuit is not linked with the secondary circuit. There is, as it were, an escape of induction from the secondary circuit, which is called the magnetic leakage. In discussing in a later lecture the testing of a transformer, we shall consider how this quantity can be measured. Having delineated the whole of these curves for a transformer, we are then in a position to draw a hysteresis diagram for the transformer. To do this, we have to set off in the form of a cycle curve the variation of induction with mag-

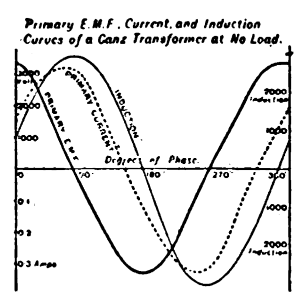


FIG. 23.

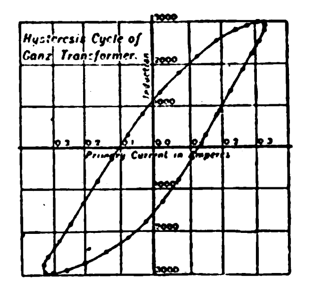


FIG. 24.

netizing force. It can easily be shown that if we construct a closed curve, by setting off on a horizontal axis the different instantaneous values of the primary ampere-turns of a transformer on open secondary circuit taken at equal time intervals during the phase, and if corresponding with these we set off the vertical ordinates representing the total induction in webers in the core of the transformer corresponding to these different values of the ampere-turns, then the total area of that curve integrated in turns of a unit of area—one side of which represents a weber, and the other side of which represents an ampere-turn to the selected scale will give us the value in joules of the energy wasted in the core of the transformer in one complete magnetic cycle, and in this manner we can determine from the transformer diagram the power wasted in watts in the core when the transformer is on open secondary circuit. This power is spoken of as the iron core loss in the transformer, and it can be determined directly from the transformer diagrams. In a later lecture we shall see how it can be more conveniently determined by one single direct measurement with the wattmeter. The diagram in Fig. 24 shows the hysteresis diagram thus determined for a Ganz transformer.

We have now briefly reviewed the chief actions going on in the transformer. Let us sum them up. If we apply to the terminals of a transformer a periodic electromotive force varying according to any law, we find that we have a periodic current set up in the primary circuit, which lags behind the primary electromotive force when the transformer is on open secondary circuit, but which gradually comes into step with it, in proportion as the transformer is loaded up. In good closed circuit transformers a very small amount of loading up—even as much as one-fiftieth of full load—will suffice to bring the primary current curve into step with the primary electromotive

*See "The Alternate Current Transformers," Vol. I. (New Edition, Page 358).

force curve. Secondly, we have a periodic magnetic induction in the core, which differs in phase, both from the primary current and the primary electromotive force, and it is found that this magnetic induction curve is always a more regular curve than the curve of primary electromotive force. When the curve of primary electromotive force is approximately a simple periodic curve, then the curve of induction is more nearly a simple sine curve. Thirdly, we have a curve of secondary electromotive force which is similar in form to, and exactly opposite in phase to, the curve of primary electromotive force when the transformer is on open secondary circuit, or when it is sending a small secondary current into a non-inductive resistance. If the secondary circuit of the transformer is practically non-inductive, as it is when the transformer is practically a load of incandescent lamps, then the curve of secondary current is always in step with the curve of secondary electromotive force, and can be deduced from it. Lastly, we have a curve deduced from the curve of induction and primary current of no load, which give us the hysteresis curve of the transformer. The curve of primary current of no load is generally spoken of as the magnetizing current, and the total power taken up in the iron core in watts is spoken of as the iron loss of the transformer.

II.—THE CONSTRUCTION OF THE TRANSFORMER.

In the previous lecture we have examined the general facts connected with the action of the transformer, and we have next to consider questions of transformer construction. The three organs of a transformer being the primary and secondary circuits and the iron core, the constructive problem is reduced to winding these circuits on the core, and properly constructing that core to receive them. We will consider, in the first place, the manufacture of the core. This has to be built up of iron wire or sheet-iron, so divided or laminated that eddy currents cannot be set up in it. If it were not for this lamination, the periodic change of induction taking place in the core would set up in the mass of the metal local electric

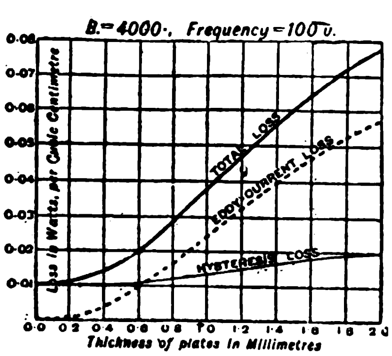


FIG. 25.—HYSTERESIS AND EDDY CURRENT LOSSES IN WROUGHT IRON PLATES.

currents which would dissipate energy. Mathematical investigation has shown that, for frequency of 100, or thereabouts, it is useless to make the iron—whether in the form of wire or sheet—less than 1-100th of an inch in thickness, that is, about ¼ mm., and useless to laminate it all, unless the laminations are less than 1 mm. in thickness. You will find in the "Electrician," Vol. 28, pp. 599 and 631, investigations by Prof. J. J. Thomson and Prof. Ewing, which deal elaborately with this matter. I have found that their rather complicated formulæ are not fitted for use in the workshop, but that they can, for all practical purposes, be replaced by a much more simple formula, which furnishes all the necessary information for transformer core construction. In the case of good sheet-iron, and for the range of induction usually employed in transformer work, which is not more than 3,000 or 4,000 C.G.S. units, that is to say, 30 to 40 microwebers per square centimetre, if we represent the eddy current loss in watts per cubic centimetre of the plates by a symbol, E; and if we call t the thickness of the plate in mils., that is, in thousandths of an inch, and if B is the maximum value of the induction per square centimetres in C.G.S. units, and n the frequency, then it can be shown that very approximately $E = \left(\frac{t\,n\,B}{10^8}\right)^2$. Although this is a hybrid formula, containing units of different kinds, and may be horrible to purists, it will nevertheless be useful in the drawing office, and we can simplify it still more if we reckon the maximum induction in webers, and call I this induction per square centimetre, then $E = (t\,I\,n)^2$. In some works it is the custom to reckon the induction per square inch, instead of per square centimetre, and the thickness of the plate in fractions of an inch. If $t_{,}$ is the thickness of the plate in inches and $B_{,}$ the induction per square inch, and $E_{,}$ the eddy current loss in watts per lb. of plates, then $E_{,} = \frac{1.4}{10^{10}} t_{,}^2 n^2 (B_{,})^2$. The general custom is to use plates for transformer construction of about .014 inch in thickness, and the standard induction which is generally selected is 2,500 lines of induction per square centimetre, or 2,500 C.G.S. units. This is equivalent to 16,125 per square inch. Under these circumstances, by the above formula, it is shown that the loss in watts per pound of

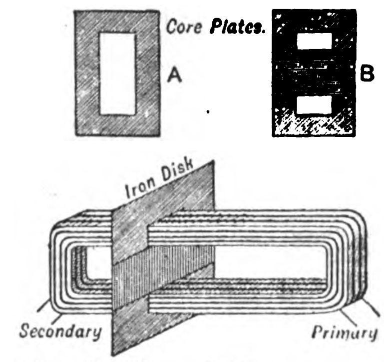


FIG. 26.—MORDEY'S TRANSFORMER.

plates due to eddy currents would be .07 watt; the frequency being 100. It may be noted that any increase of temperature as the transformer is worked, by increasing the resistance of the iron tends to diminish the eddy current loss. It will, therefore, be seen that by employing plates of a thickness not greater than 14 mils. eddy current loss is reduced to a very small amount. One point, however, to which your attention ought to be called is, that unless the iron plates are properly arranged, eddy current loss may exist in them, however thin they may be. If, either by reason of magnetic leakage, or any other disposition of the magnetic induction, lines of magnetic induction move through the iron in such a manner that their direction is not always parallel to the direction of the lamination of the iron, then, under those circumstances, eddy currents may be set up in the core, which are not hindered by lamination. This source of waste was present in many of the earlier forms of transformer. In addition to the loss of energy caused by eddy currents in the core, there is, of course, that other source of loss called the hysteresis loss, which is due to the magnetization and demagnetization of the core, and to the fact that the induction is not in step during the whole period with the magnetizing force, but lags behind it. The investigations of Steinmetz have shown that the hysteresis loss in iron sheets can be represented by a simple empirical formula which fits the facts fairly well. It is found that the hysteresis loss per cubic centimetre per cycle in the iron is related to the maximum value of the induction during the

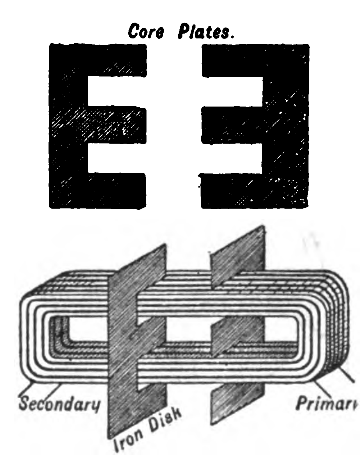


FIG. 27.—WESTINGHOUSE TRANSFORMER.

cycle by a simple exponential law, and may be, for all practical purposes, closely expressed by the following formulæ:—

Let H = hysteresis loss in watts per cubic centimetre,
and H^1 = hysteresis loss in watts per lb.,
then $H = \eta\, n\, B^{1.55}\, 10^{-7}$
$= {\cdot}0032\, n\, B^{1.55}\, 10^{-7}$.

Where n in the above formula is the frequency, and η is a coefficient called the hysteretic constant, which depends upon the

nature of the iron. The value of η may vary from .002 to .005. If we reckon the hysteresis in watts per lb., then we have

$$H_{,} = 0{\cdot}88_{n}\,(B^{1})^{1\cdot55}\,10^{-9},$$

where $B_{,}$ = induction per square inch.

The exponential constant may vary from 1.55 to 1.6. Thus, for example, if n = 100, and if $B_{,}$ the induction per square inch = 16,125, corresponding to induction per square centimetre of 2,500, the $H_{,}$ = .29 watt per lb., and H = .005 watt per cubic centimetre. These formulæ have been deduced from experiments made with various kinds of transformer iron; and although they are empirical formulæ, in the sense that they are not deduced from first principles, yet, nevertheless, they are exceedingly useful, and agree so well with experience, that they enable us to calculate the hysteresis loss at any one induction, when we know it at another. We may, therefore, put together the two expressions obtained for the eddy current loss of the hysteresis loss in iron, and state that, for all practical purposes, and within the limits of the induction usually em-

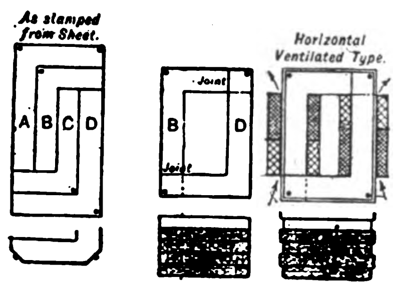


FIG. 28.—SCOTT TRANSFORMER.

ployed in transformers, the total energy loss in the iron, made up partly of eddy current loss, and partly of hysteresis loss, may be expressed as follows:

T = the loss per watts in cubic centimetres ;
$T_{,}$ = the loss in watts per lb.; then

$$T = {\cdot}0032\,_{n}B^{1\cdot55}\,10^{-7} + \left(\frac{t\,_{n}B}{10^{8}}\right)^{2}.$$

$$T = {\cdot}088\,n\,(B_{,})^{1\cdot55}\,10^{-9} + \frac{1{\cdot}4}{10{\cdot}10}\,(t_{,}\,n\,B_{,})^{2}.$$

Where B is the maximum induction in C.G.S. units per square centimetre, and $B_{,}$ per square inch.

The curves in Fig. 25 show the variation of hysteresis and eddy current loss in plates of various thickness for a maximum value of the induction of 4,000 C.G.S. units calculated from the formulæ of Prof. J. J. Thomson.

My own experience is, that these formulæ agree very well with experience and with the results of measurement. I made some years ago a careful study of the old form of Ferranti transformers, and found a very fairly close agreement between the results of measurement of the core loss in these transformers and the results obtained by calculation from the above formulæ. In specifying for iron for use in transformers, it is now the custom to adopt a standard induction of 2,500 C.G.S.

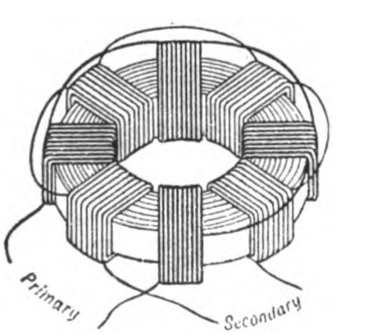


FIG. 29.—TYPICAL CLOSED CIRCUIT TRANSFORMER.

units, or lines of induction per square centimetre; that is to say, the standard induction is 25 microwebers per square centimetre—and the standard frequency is 100. Under these conditions a good transformer iron ought to have a hysteresis loss, varying from .25 to .5 watt per lb. It is possible, under some conditions, to get iron with less hysteresis loss than this, but as we shall see presently, there are some difficulties in keeping it in this condition. Having selected the iron, the next thing is to stamp out the core plates, and afterwards to carefully anneal them. It is now well understood that the slightest tooling or handling of iron after it has been annealed hardens it, and raises its hysteresis loss—hence the greatest care has to be taken that the plates are not damaged after annealing. The plates have then to be insulated to keep them from electric contact with one another. The old practice was to insulate the plates with thin paper, but paper takes up too much space, and it is now usual to paint the plates with an insulating paint or varnish, which, however, must be able to withstand, without deterioration, the highest temperature which the transformer may reach in work. Even using varnish, the varnish takes about 10 per cent. of the space of the iron. In selecting the iron for the core plates, it is more important to choose an iron with small hysteresis loss than large permeability. These two things are not necessarily connected together. The number of devices which have been adopted for cutting the iron into the core plates, as to avoid unnecessary waste of metal, is very large. In Fig. 26 is shown the manner of building up the core of a Mordey transformer. In Fig. 27 the mode of building up a Westinghouse transformer is also shown. In this case, as in that of the Mordey transformer, where a cross piece is used, or where there are overlapping iron plates, it is customary now to use packing pieces of sheet iron to fill in the levels, and to get as much iron as possible into the space. In Fig. 28 is shown the method of stamping the core plates from the sheet and constructing the Scott and Addenbrooke transformer. The iron core having been constructed in such a manner as to afford a completely closed iron circuit for the lines of induction due to the magnetizing force of the primary coil, the core is then covered with shellaced calico and mica, in order to insulate it from the primary coil; and the greatest care ought to be taken in this respect, because it is not sufficient to insulate the coils of the transformer from one another: they must both be insulated from the core. Thin ebonite is often used as a material for insulating the core, and an India-rubber compound called woodite is a very good material to use. The primary and secondary coils are generally wound on formers; they must be insulated from each other by ebonite or mica, and the primary and secondary coils should be so overlayed or intermingled (as shown in Fig. 29, which represents a typical closed iron current transformer) to avoid producing magnetic leakage. In large transformers it is customary to leave a space between the high and low tension coils for the purpose of ventilation, and in the same way air spaces or ventilation spaces have to be left in the iron core. The primary and secondary coils are sometimes separated from one another by a metal shielding plate, which is connected to earth. This is, however, not so good a plan as an effectual separation of the primary and secondary coils by an insulating shield. In the design of the core it is important to reduce the reluctance of the magnetic circuit as much as possible, in order to produce a large power factor. The term "power factor" is defined as a number representing the ratio between the true power taken up in the core to the product of the primary potential difference and the primary current (root-mean square values being understood). This product is called the apparent power taken up in the core.

CONTEMPORARY ELECTRICAL SCIENCE.

The Aurora Borealis was the subject of much discussion at the Lübeck conference of German physicists and physicians. Herr Ebert described some experiments, summarized in Wiedemann's "Beiblätter," which attained a considerable measure of success towards imitating the celestial phenomena in question. Spheres, plates, and cylinders of brass and of iron were exposed in a vacuum to electromagnetic waves. Halos and auroras were observed to encircle them, and these were powerfully influenced by magnetic forces. Up to a certain point their luminosity increased with the strength of the magnetic field, but where the lines of force impinged vertically on the surface the aurora was thrust aside. All this points to the explanation that the sun sends out electromagnetic waves which produce the aurora at the more intense points of the earth's magnetic field. Another speaker, Herr Paulsen, of Copenhagen, inclined rather to the view that the aurora, especially the steady glowing kind, is due to a fluorescence of the air under the influence of cathode rays emitted by the sun, the distribution of the fluorescence being governed by the earth's magnetic field. Since these rays facilitate the production of ozone, and the latter is a strong cloud-former, we have also an explanation of the cloud formations which almost invariably attend the displays. In the "Physical Review" we have another lady student of the electric arc. Miss Caroline Baldwin studied the spectrum of the arc photographically and found that carbon spectrum is chiefly formed at the negative carbon, and its brilliancy is increased by zinc, cadmium, or copper cores. The carbon bands are only few at the positive carbon; and cores of the light posi-

Dent du Midi. The Mole. Aig. Verte. Mont Blanc.

SUMMIT OF MONT SALEVE AND TERMINUS OF ELECTRIC ROAD FROM GENEVA, 4,000 FEET ELEVATION. WITH DISTANT VIEW OF MONT BLANC.

tive metals, potassium, sodium, lithium, and others, so effectually screen them that it is not surprising they escaped Prof. Snow's bolometer altogether.—London "Electrician."

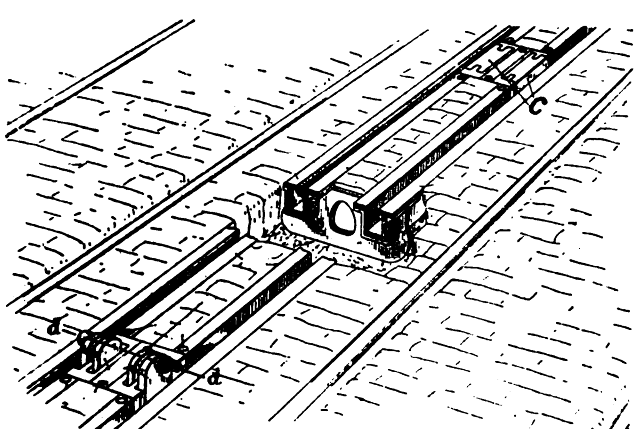
ELECTRIC TRANSPORTATION.

LINN'S ELECTRIC CONDUIT RAILWAY.

BEFORE even the time when the overhead trolley had achieved any considerable success, the idea of a sectional conduit system, in which the current should be always confined to the section of the roadbed directly beneath the car, was being prosecuted by a number of inventors.

This field still remains an open one and will undoubtedly prove a profitable one to the inventor of a thoroughly practicable sectional conduit system whose cost of installation is not prohibitive.

We illustrate in the following diagram a system of the sectional conduit system invented by Mr. John B. Linn, of Cleveland, O. In this system the conduit is designed to be placed on the roadbed outside of the tracks, or, as in the illustration,



LINN'S ELECTRIC CONDUIT RAILWAY.

if the track is a double one, both conduits are placed close together in the space between the two pairs of tracks. A runner is carried along the side of the car, whose ends bend downward and travel in the conduit slot. At intervals of less than the length of a car the switches c, d are placed at the surface of the conduit. When in the position c the main conductor which is below in the conduit is cut off from the switch which consequently carries no current. But as the car passes, the forward end of the runner on the side of the car raises the switch into the position shown at d, in which position it is brought into contact with the main conductor and conducts the current to the car motor by means of a suitable collector. The switches are spaced so that before one leaves the runner at the rear end of the car, the next switch will be raised by the front end of the runner, making the contacts not only successive but continuous.

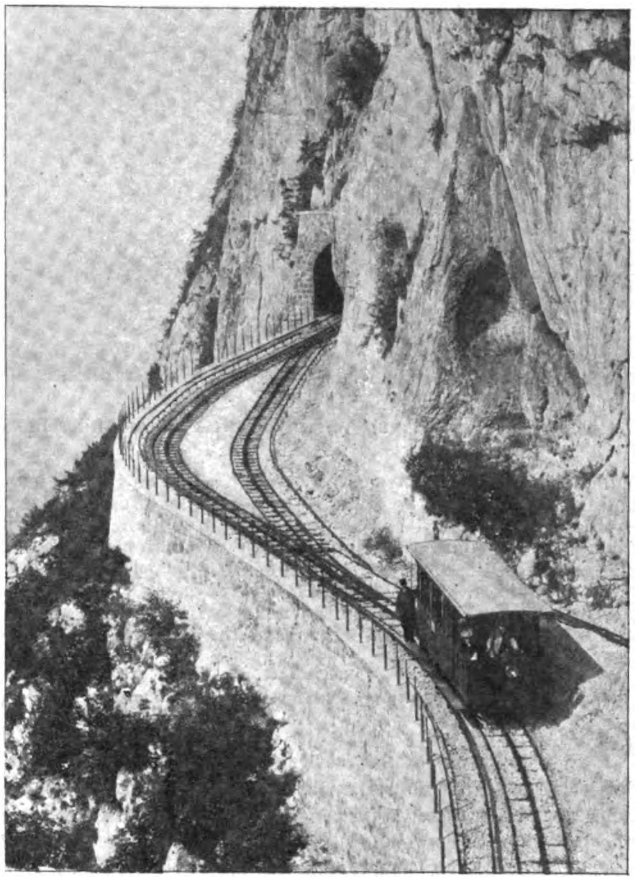
THE ELECTRIC RAILWAY UP MONT SALEVE, GENEVA.

ONE of the most striking features in the present electrical development of Switzerland is the manner in which the loftiest peaks are being attacked by electric railway engineers, with the object of building roads to their summits or else up to the best points from which tourists can view the surrounding ranges and valleys. The recent National Exposition at Geneva, and the holding of an electrical congress there, has given special prominence to the road that has been carried up and around Mont Saleve, a huge mass towering above Geneva to a height of over 4,000 feet and giving from its plateau at the top a magnificent view of the whole pile of Valaisian Alps, beginning with Mont Blanc itself on the right, to the south and west, and ending with the Dent du Midi, the Dent d'Oche and Lake Leman to the left, on the north and east. There are other Alpine panoramas to be obtained by means of electric railway ascents, in other parts of Switzerland, but this view cannot be surpassed.

While in every sense a Swiss road, the Chemin de Fer Electrique du Salève runs chiefly over French territory, just as Mont Blanc, the glory of Switzerland, is essentially a French or Italian mountain. The visitor leaves Geneva by the ordinary trolley line to the outskirts of the city, then exchanges to a clumsy steam tramway, and then embarks on the mountain electric road. The lower portions of the line are in constant operation, but the travel over the upper section to Treize Arbres (Thirteen Trees), on top of Mont Saleve, is limited between June 1 and September 15, and even then some of the dispatches are not made unless the weather is fine, for there is nothing more dismal and melancholy and dangerous than a Swiss mountain in bad weather.

The electric part of the road is about 4 miles in length, single track and turn-outs, and of twin lines built so as to form a loop, giving the passenger alternative routes. It was built and equipped by the well-known Compagnie de l'Industrie Electrique of Geneva. The system used is that of the third rail, the contact apparatus being placed outside the track, and the current-carrying rail being placed a few inches above the ground for insulation, on short posts. The gauge is one metre. Between the rails, which are solidly laid on a well ballasted

track, runs a rack rail. Where the grade is extreme, the rack is double, the teeth being set so as to give the car a two-fold grip. Additional security is furnished by air-brakes, but even then the experience is found quite exciting by the passengers, especially where the grade reaches 25 per cent. and where curves at not much less are taken on a 35 metres radius. Current is supplied to the line at a potential of 600 volts for a water power plant, and is brought to the road across the mountain sides by aerial cables connected about midway in the system. Each car has two Thury 4-pole motors of 25 horse-power each, and there are 12 motor cars and 4 trailers. The generating plant at Arthas, away down in the recesses of the deep cut Arve Valley, has two Thury dynamos of 165 horse-



Steep Grade, Turn-Out and Tunnel, Mont Saleve Electric Road. Section Overlooking Geneva and Lake Leman.

power each, and a small exciter of 15 horse-power, and the two turbines are of the Richter make, with vertical axis, each being of 185 horse-power. The generators are 12-pole machines, and each weighs 19 tons. Everything about the plant, line and rolling stock is solid, and the road is carefully operated.

After climbing the precipitous face of the mountain, overlooking Geneva and the lake, and giving beautiful glimpses northward of the rushing blue Rhone and of the Jura Alps, the road passes through a tunnel and comes out on the inner side of the Little Salève. It then proceeds, rising rapidly, up the valley of the Arve until it reaches by various turns and detours, the summit of the Great Salève. The views are extremely fine all the way up, the winding Arve being almost always in sight with its brown waters rushing from the glaciers of Mont Blanc to join the blue pellucid Rhone streaming out of Lake Leman at Geneva. On top of Salève is a large restaurant from whose balcony and windows on any clear day Mont Blanc is in full evidence, while if the day is not clear, one may be lucky enough to see tremendous effects of light and shade and of storm and cloud rolling over the eternal snowy peaks. It is needless to say that the road is well patronized, and as good rates of fare are charged, there is no reason why the owners should not be well satisfied with their investment.

TROLLEY FARES RAISED IN DETROIT.

The Citizens' Street Railway Company, controlling about ninety miles of track, has returned to the old plan of selling six tickets for a quarter. For seven months and a half patrons have been getting eight tickets for 25 cents. The managers claim they have spent $4,000,000 in putting in the best system of electric railways in the country, and they cannot get a fair return on the investment at the low rates. It will be interesting to see what Mayor Pingree says now.

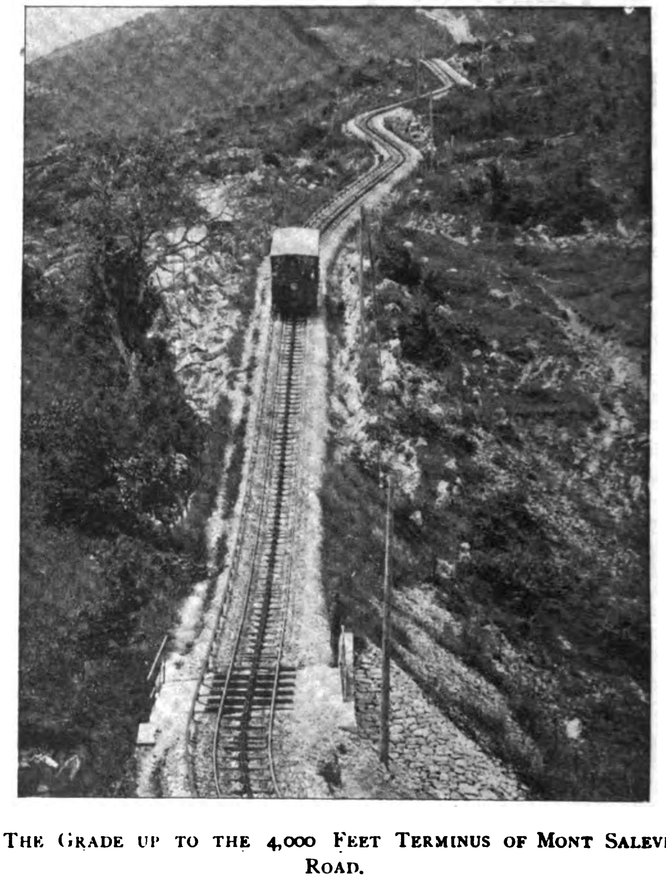
A "PAPER" ROAD SCHEME IN MILWAUKEE.

A special dispatch from Milwaukee, Wis., of August 17, to the Chicago "Journal," says: The movement to secure competition in the street railway business in Milwaukee has proved a grand fizzle. The "Milwaukee and Waukesha Electric Railway Company," an alleged corporation possessing no corporate existence, was granted a franchise by the common council a short time ago to build and operate a street railway system. The franchise provided for paralleling the tracks of Henry C. Payne's local railway monopoly, the Milwaukee Electric Railway and Light Company. It was provided in the franchise that the company to which it was granted should never pool issues with, sell out to, or enter into a combination with any other street railway company. The promoters of the so-called Milwaukee and Waukesha Electric Railway Company claimed to have purchased the railway of the Milwaukee and Wauwatosa Motor Railway Company, a bankrupt concern.

During the past few days negotiations have been pending for the sale of the motor railway to the local street railway monopoly, with the proviso that in the event of the purchase being effected the new street railway scheme should be abandoned. Henry C. Payne and the other officers of the local monopoly considered the proposition, as well as the granting of the franchise by the common council as the culmination of a sand-bagging scheme, and have given the facts to the press for publication.

When the franchise was before the common council for consideration its passage was opposed by nearly every paper in the city, on the ground principally that the promoters of the Milwaukee and Waukesha company were not men of wealth and were unable to make any showing of possessing or being able to obtain the necessary capital to build the proposed road.

It was also shown at the time that the company had not been

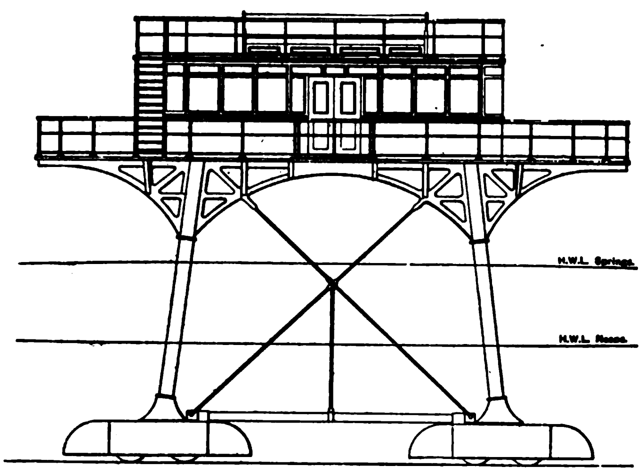


The Grade up to the 4,000 Feet Terminus of Mont Saleve Road.

incorporated, and even at the present time it has no corporate existence. It does not now seem probable that any use will be made of the franchise granted it, and it will probably be forfeited through a default in complying with its provisions.

THE BRIGHTON—ROTTINGDEAN SEA TROLLEY ROAD.

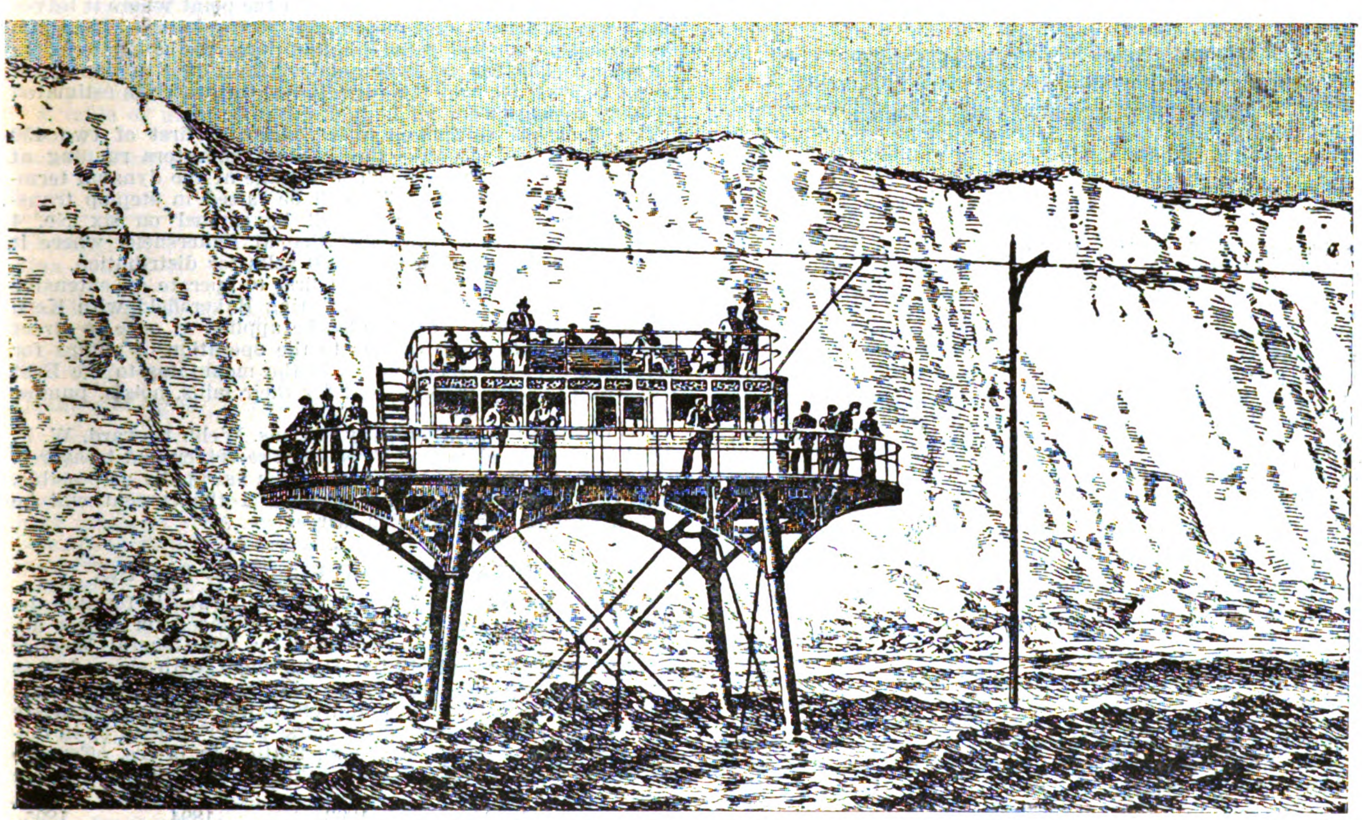
SOME months ago we called attention to the novel transmarine trolley railway proposed by the indefatigable worker, Mr. Magnus Volk, for the stretch of seashore between Brighton and Rottingdean, on the south coast of England. This curious and interesting road has now been finished and is



MOTOR CAR, BRIGHTON-ROTTINGDEAN TRANSMARINE ROAD.

certainly well worthy of notice, while it is to be hoped that the company will be handsomely rewarded for its courage and enterprise.

The rails run along the foreshore at a distance of about 150 to 250 yards from the base of the cliff, slightly above low-water mark; at high tide they are covered by 14 feet of water. Instead of two rails connected by tie-rods, there are two pairs of 54 lb. rails, a distance of 18 feet intervening between the two outers. Each pair of rails (2 feet 8½ inch gauge) is laid separately, on concrete blocks mortised to the chalk below. In 1893, when the act was obtained, the chalk was covered in some places by a layer of sand 3 feet thick. During the storms of last winter the sand was all swept away, to be subsequently slowly silted up again. The steepest gradient is 0.3 per cent.; the sharpest curve has a radius of half a mile.



VOLK'S TRANSMARINE TROLLEY ROAD, BRIGHTON TO ROTTINGDEAN, ENGLAND.

The car, which was designed by Mr. St. George Moore, joint engineer to the company, with Mr. Volk, was constructed by the Gloucester Wagon Company. It is supported by four splayed-out legs, each leg consisting of a 12-inch steel tube, running on a four-wheel bogey. The wheel base is 28 feet. Each of the two leading bogies is driven off vertical shafting inside the tube by a 30 horse-power vertical motor, to which current is conveyed on the overhead trolley system at a pressure of 500 volts. The deck of the car is 24 feet above the rails, and measures 50 feet by 22 feet; it carries a saloon 25 feet by 12 feet. The structure by itself weighs 40 tons, and with motors, gearing, and 150 passengers, the total weight is 60 tons. The speed is six miles an hour.

The deck appurtenances, says "Invention," to which we are indebted for one of our illustrations, are carried out as if for a steam yacht. The railings surrounding the deck are made of iron with a wooden top and safely barricaded with wire netting. An ample supply of seats are to be seen with reversible backs, so that the passengers can face in any direction in which the car is traveling. A saloon is placed in the center of the deck, measuring 12 by 25 feet, and is provided with plate glass windows, and a large ottoman, with palms and flowers growing in a center box. A stained glass dome rises over the center, and outside is a second gallery, railed round, forming a promenade with deck seats.

THE LIVERPOOL ELEVATED ELECTRIC ROAD.

The Liverpool (England) elevated electric road again makes a good showing. During the first half of this year some 313,010 train miles were run over the six miles of line now working, and 3,739,575 passengers have been carried. The revenue accruing from passengers, together with the carriage of parcels, etc., has amounted to 23.9d. per train mile; while the total expenditure out of revenue has not exceeded 15.1d. per train mile, or approximately 63.2 per cent. Out of this last-named sum, the total generating expenses at the power station have absorbed 3.39d. per train mile, of which only about one-half penny per train mile has been paid for fuel. The rolling stock, consisting of 38 coaches of 56-passenger capacity, or 19 trains of 112-passenger capacity, has not been increased; but work has been pushed forward on the extension of the line, and the additional mile or so which is now being constructed will, it is expected, be completed by next autumn. The sum of £11,166. 7s. 5d. is available for the 5 per cent. dividend on the Preference shares, and the 2¾ per cent. dividend on the Ordinary shares.

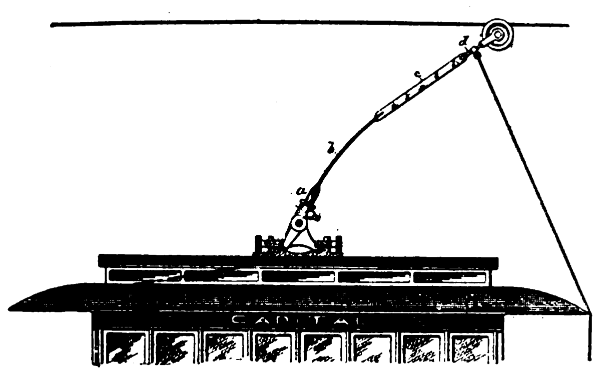
PROF. SHORT'S SPRING TROLLEY POLE.

A SIMPLE trolley pole has been invented by Mr. Sidney H. Short, of Cleveland, Ohio, which is designed to keep the trolley wheel against the wire, with the proper degree of pressure, without the use of springs or weights, and a general view of the same, mounted on a car, is shown in the accompanying engraving.

On the roof of the car a base is fastened having two lugs which project upwards and through which screw-stops are threaded.

The base is provided between its ends with arms between which a socket-piece is supported by means of a pin. The socket-piece holds the lower end of the trolley pole. The trolley pole is made of spring or elastic material, so that the trolley wheel at its free end will be maintained in contact with the under face of the trolley wire with the necessary degree of pressure, entirely independent of any auxiliary springs such as are generally used for this purpose.

The spring trolley pole should be constructed so as to give sufficient lateral motion to permit the trolley wheel to keep its contact with the wire on curves and switches. It should be made of spring steel, and its lower end, a, is made cylindrical in form and is inserted into the socket piece in which it is held by means of a set-screw. Immediately above the lower round portion a the pole is made with a flat or ribbon-like section b. In other words, the section b of the pole is so formed as to permit the pole to bend toward or away from the car, and so that the resilience of the portion b will act to press



SHORT'S SPRING TROLLEY POLE.

the trolley wheel against the wire. The section c is also made flat, but its longest diameter is fixed at right angles to the longest diameter of the section b, and the free end d of the pole, to which the trolley wheel is attached, is made round in cross section and quite small as compared with the lower end or section a of the pole.

From this construction of the trolley pole it will be observed that its most elastic portion with respect to the trolley wire and the roof of the car is in the section b, which is nearer the roof of the car than the trolley wire, and as the section c cannot bend in the same direction as section b there will be no liability of the upper portion of the pole striking the trolley wire. By making the section c of the pole flat in a direction at right angles to the section b the necessary lateral movements of the trolley wheel will be readily permitted.

When the pole is in operation the lower end of the socket will be in engagement with one of the stops and it will have no movement whatever. All movement of the trolley wheel as it runs against the wire is permitted by the spring of the trolley pole itself. When the direction of the car is to be changed, the pole will be then turned, so that the lower end of the socket will bear against the opposite stop.

By means of the adjustable stops the tension of the spring pole can be regulated and the pressure of the trolley wheel against the wire adjusted.

THIEVES CARRY OFF TROLLEY WIRE.

At an early hour on August 18 thieves stole about a thousand feet of feed wire from the Camden, Gloucester and Woodbury trolley road in the region of the bridge, near Mantua, N. J. Men with some knowledge of electricity must have committed the theft, as no depreciation in the current was felt at the power house, nor along the line, as would have been the case had the current been grounded or the circuit opened. The scene of the robbery is rather lonely at such an hour.

POWER TRANSMISSION.

THREE-PHASE POWER PLANT ON THE KERN RIVER, CALIFORNIA.

THE power of the Kern River, the third largest stream in California, is now about to be utilized, the work undertaken by the Power Development Company being nearly completed. The contract for the electrical equipment has been awarded to the General Electric Company, whose three-phase apparatus will be used to transmit the power of the river to Bakersfield, a distance of fourteen miles as the bird flies.

The point selected for the power house is at the mouth of the canyon on the north side of the Kern River, almost sixteen miles northeast of Bakersfield by wagon road. Here the stream, after a boisterous course of 100 miles from the slopes of Mt. Whitney through a series of rugged precipitous canyons forms a number of cataracts and rapids previous to taking a placid course through the cultivated valley lands. The point of diversion of the necessary flow for the power is some 9,000 feet up the canyon. To secure a bed for the flume a roadway had to be cut from the solid rock along the sides of the canyon. All the timber was hauled by a team a distance of sixteen miles to the south side of the river. A bridge was thrown across and a tramway 325 feet long with a grade of 30 per cent. laid up the steep hill to the point where the flume was to end. A steam sawmill was then set up at the foot of this tramway, the timber cut to proper dimensions, loaded on the cars and hauled up the grade.

The flume was begun at the power house end. This flume is 8 ft. wide and 6 ft. deep and is covered. A railroad track is laid upon the cover for the full length of the flume, 8,000 feet. There are no sharp angles, the changes in the course being made by curves and tangents. The grade is 5.8 to the mile, and 475,000 feet of red wood is used in the construction of the flume which at one point is carried on an arch with 60 ft. span over a bad place on the cliff. The flow is calculated at 280 cubic feet per second. At its terminus at the mouth of the canyon 8574.9 feet from the point where it leaves the river, it is 202 feet above the power house. Here the water enters a steel pipe 540 feet long and 5 ft. 6 in. in diameter. The fall from the end of the flume to the power house is 201.9 ft., and the capacity of the water is estimated at 7,500 horse-power.

The electrical equipment will consist at first of two 450 kilowatt General Electric three-phase generators running at 257 revolutions per minute. The voltage at the dynamo terminals will be 550 volts. This will be raised in step-up transformers to 11,000 volts and will be carried on six No. 4 bare copper wires to the substation at Bakersfield, where it will be transformed down to 2,000 volts for distribution.

The current will be utilized at first to operate an extensive system of electric railroads connecting Bakersfield with Kern and other districts. It will also be applied at once to street and house lighting, as well as to the operation of pumps for irrigation purposes. The mines in the mountains to the East will also probably take current for their mills, hoists, pumps, etc.

The president of the company is Chas. Webb Howard, W. F. Goad is vice-president and C. N. Beal secretary and treasurer. The work is being pushed to completion as rapidly as possible, and it is expected that by November 1 the current will be turned into the transmission wires.

SOME STATISTICS OF ELECTRIC POWER.

The economy and efficiency of electric power is forcibly demonstrated by the extent of the orders placed for power apparatus. We have been furnished by the General Electric Company's Power and Mining Department with some figures which illustrate not only the growth in the use of electric power, but also its economy and efficiency. These figures are represented in the unfluctuating horse-power instead of in dollars which, on account of the fluctuation in prices, offers no standard gauge. The figures taking cognizance of electric power apparatus only:

	1892.	1893.	1894.	1895.
Horse-power	13,719	18,762	42,379	46,727

In 1896 the missionary work of the past four years began to come to rapid fruition. From January 1 to July 31, the total horse-power of the apparatus amounted to over 48,000 horse-power. During the same period in 1895 the aggregate orders amounted to 25,737 horse-power. From Jan. 1 to Aug. 18, the total amount of power apparatus ordered during 1896 was increased to the respectable figure of 62,164 horse-power.

Such a showing in face of the universal dullnes in business everywhere is remarkable, and perhaps emphasizes the fact that during hard times the truest economy is the use of apparatus which costs least to operate. It is said that in every manufacturing establishment using electricity as its motive power, the output has not only been increased, but its quality improved.

INTERNATIONAL CONGRESS OF ELECTRICAL ENGINEERS AT GENEVA.

THE Congress, which has just come to a close, was opened on Aug. 4 by Mr. Th. Turrettini. Among the 230 members present, we may mention Messrs. Ferraris and Mengarini, from Italy; G. Knapp and Von Hefner-Alteneck, of Berlin; Mascart, Hillairet, and J. Blondin, of Paris; and C. S. Bradley, of New York. A few English electricians also attended the meetings, but the Institution of Electrical Engineers, of London, was not officially represented.

The first report was by Dr. Wietlisbach, of Bern, on "Telephonic Disturbances Caused by Electric Traction." The following precautions were advocated:

1. Where telephone wires cross a trolley line used for pressure not exceeding 750 volts, it is sufficient to protect the wires by fuses.
2. Where the pressure used is above 750 volts, the trolley line must be efficiently connected to earth.
3. The telephone companies are strongly recommended to use double wire.

On the question of magnetic units, a paper was read by Prof. Ed Hospitalier, of Paris, recommending the conclusions of the American Institute of Electrical Engineers. The Congress, after a long discussion, adopted the C. G. S. system as practical units, and gave the opinion that it was not necessary to use any special nomenclature. According to this decision such names of units as Gauss, Weber, Gilbert, etc., would be abandoned.

The report of Mr. André Blondel on "Photometric Units" was the next to be read. The decimal candle = $^1/_{20}$ violle, adopted by previous Congresses, is maintained. It can, however, be provisionally represented for practical purposes, and within a few per cent., by the Hefner lamp.

A table of units of light adopted by the Congress is given below:

	Name of Unit.	Definition.	Dimen ions.
Intensity........	Candle.	I	I
Flux..............	Lumen.	$\phi = I\delta$	I
Illumination......	Lux. (= lumen square metre)	$E = \frac{\phi}{S}$	I L^{-2}
Brilliancy........	Candle. (per square centimetre)	$i = \frac{I}{S}$	I L^{-2}
Quantity of light..	Lumen-hour.	$Q = \phi T$	I T

The opinion of the Congress was also solicited on the subject of the protection of overhead lines from atmospherical discharges. Various well-known magnetic and mechanic lightning arresters were advocated. The method of putting both poles to earth through a water resistance was said to give very good results. In the case of continuous currents, it was recommended to place in series with the lightning arrester a self-induction, and again between this and the dynamos, a capacity, the bed-plate, as well as both poles of the machine, being carefully insulated.

One day was devoted to the question of "Transmission of Power at Long Distances," Mr. Thury, of Geneva, defending, with much ability, his high tension continuous system against all opponents.

Much care was taken to provide accommodation and entertainment for the members of the Congress, and all foreign delegates were welcomed with the utmost cordiality and kindness. During the week several brilliant receptions were held, and various electrical works in the neighborhood were visited. The Congress is being followed by an excursion, which will include visits to the most interesting technical installations in Switzerland.—London Electrical Review.

"LITTELL'S LIVING AGE" is to add next November a monthly supplement, free of charge to subscribers, which will give excerpts from the magazines and new books, and a list of new publications of the month. Occasional translations will also be given from the reviews and magazines in foreign languages.

LETTERS TO THE EDITOR.

A MAYOR IN SEARCH OF LIGHT.

I am authorized by the City Council to correspond with various companies manufacturing electric light machinery to ascertain the probable cost of equipping a plant in Des Moines for the purpose of lighting the streets, etc., and possibly furnish private consumers. Our last appropriation for lighting our streets and public buildings amounted to $50,000, and we find that the expenditures for the year will amount to about $52,500. For this amount we operate 167 arc lights, moonlight schedule, 121 arc lights on all-night schedule, 938 gasoline lamps, seventeen incandescent lamps, 318 gas lamps, also gas for City Hall, etc.

We also ask your opinion as to whether the city can maintain and operate an independent plant, the capacity of which would be sufficient to furnish the lights above stated, at a cost that would reduce the amount expended at present for such service. Any information in detail that you can give us will be appreciated. JOHN MACVICAR, Mayor.

City of Des Moines, Ia., Aug. 20, 1896.

ON THE USE OF FUSES AND MAGNETIC CIRCUIT BREAKERS.

In your issue of August 12 there appeared an interesting article by Mr. Wm. Baxter, Jr., in which he called attention to the fact that if the size of the generator be sufficiently increased in proportion to that of the engine, then, in case of an overload, the engine will be overpowered and stop; and thus do away with the need of any fuse or circuit breaker. Even granting the premise, it seems to me that this is an exceedingly expensive substitute for a fuse. If, on the other hand, we should cut down the size of the engine, instead of enlarging the generator, we would simply defeat the object that we have set out to accomplish. I fail to see how the arrangement proposed would avail anything that a fuse would not accomplish. In case of short circuit or overload it would protect the dynamos by putting the lights out. The practical station man cares little whether his circuit is complete in a metallic sense or not if his engine is not running. His aim is to give uninterrupted service, or, if accident should leave his customers in the dark, to re-establish the circuit just as quickly as possible; and I promise him that he can throw the lever of his circuit breaker quicker than he can start up his engine.

Though Mr. Baxter has thrown out one good suggestion, the problem for most of us is probably just as vexing as ever. Perhaps the best protection to the customer, aside from installing an ample capacity of both engines and dynamos is the expensive method of keeping a storage battery in parallel with the generators, or so connected that it will be cut in automatically in case it is needed. There are many stations where the presence of the battery would be justified by other reasons. Yet the battery should in general be protected by a circuit breaker of some sort.

This discussion is rather one of station design than of protective devices, the use of which latter, I fear, must be decided for each individual case in the future as it has been in the past.

GEO. R. ALBERS.

University of Kansas, August 15, 1896.

LITERATURE.

MOLECULES AND THE MOLECULAR THEORY OF MATTER. By A. D. Risteen. Boston: Ginn & Co. Cloth. Illus. 8vo. 223 pages. Price, $2.

This is a book that has been out some little time, but which we venture now to recommend to our readers, not a few of whom will find it of help in the study of the subject, and especially useful at a time when the discussion of the X-ray has set all the molecular theories and electrical phenomena in a new and puzzling aspect. Prof. Risteen first takes up the molecular hypothesis and then deals necessarily with the kinetic theory of gases, the molecular theory of liquids; the molecular theory of solids; molecular magnitudes; and the constitution of molecules. The book is based on a series of lectures, but is none the worse for that, as it gives a freedom and play to the expression and thought that is welcome, and, for many students, a positive help.

THE

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[INCORPORATED.]

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CONTENTS.

OTHER CARS THAN ELECTRIC.

THE latest statistics published as to the overwhelming adoption of electricity on street railroads would go to show that for a little while at least the method of operating surface rapid transit systems in America would remain fairly well settled. It is not conceivable that the whole plant can be again changed at an early date, even if we escape the evils of a silver basis, and enjoy the prosperity due to a single definite gold standard. The investment that has been made during the last ten years must pay for itself, and aside from financial considerations we are of opinion that something better than the trolley for the bulk of the work has still to be brought forward. It is true there has lately been a little stir over the compressed air cars now on trial in New York City, but the claims made for them remain to be proven and the verdict of previous experience is dead against them, as it is against steam applied directly for similar work.

In the August issue of "Cassier's Magazine" we find an article by Mr. George S. Strong, who is well known as an inventive engineer, and who on this occasion comes forward as the advocate of gas cars. He presents a series of figures which enable him to dismiss from consideration electricity and compressed air, on the score of expense and inefficiency, and he goes so far as to say that if electrical locomotives were furnished free coal a railroad company could not afford to own them. As a reply to such statistics we would refer only to the recent articles in our columns by Mr. W. Baxter, Jr., who came to a very different conclusion. But the main point in Mr. Strong's article is his contention that gas, and compressed gas at that, will solve the problem alike for regular railroads and for street car lines. There can be no question as to the greater use of gas engines in the near future, probably in far larger units than the public is now familiar with, but their utility is far more likely, it appears to us, to be found in helping to generate electric current than in superseding electric motors.

Mr. Strong asserts: "For street car work, compressed gas with the gas engine makes it possible to run a car 750 miles with one charge and at a cost of less than one-third what it now costs to run the same car by electric motor, or one-third what it is likely to cost for the compressed air motor." This is a splendid showing—on paper—but we confess our scepticism as to the existence now or later of a gas car able to run 5 miles an hour for a solid, uninterrupted week, or three-quarters of the way to Chicago, on one charge of gas.

With Mr. Strong as a pessimist on the subject of electric traction must be classed Mr. J. Sturgeon, who, in a paper read before the Tramways Institute of Great Britain and Ireland, a week or two ago, came forward to advocate the cable as against electricity. It is interesting to learn from this gentleman that the history of electric traction for tramways has been one continuous record of financial failure! According to him, overhead electric traction had already seen its best days, and was doomed to follow in the wake of the accumulator; so now there were signs and tokens of another new departure in the form of conduit systems of electric traction. Still, according to this authority, all was useless, for there is nothing in

the nature of such systems to lessen the cost. "It was a hopeless task that electric tractionists had taken upon themselves, and the new departure was bound to depart, too, on the same road as the others." The effect of these gloomy vaticinations was greatly spoiled by their author's attempt to crack up a new form of cable gripper, but it is simply amazing that such talk can be indulged in freely when the real facts are readily ascertainable as to the enormous and enlarging success of electric traction in every part of the civilized globe. Even England will have her fair quota of electric roads, of one type or another, in due season, and Mr. Sturgeon will have to seek other markets for his gripper.

A CITY IN THE CLOUDS.

IT is natural that in a region where there is an absence of hills, the people should show a liking for tall buildings that will enable them to get up in the air and survey the surrounding country. The development of the modern high office building in Chicago is certainly attributable in some degree to the flatness of Cook County; and now that the tendency has become more pronounced, the taste growing by what it feeds upon, there is a likelihood that even in cities where the topography does not invite to the construction of lofty edifices, their number will rapidly increase, for purposes of business and pleasure alike. Electricity with its special advantages in elevators, lighting and power distribution has done much to help forward this new departure in building, and, as in the case of the proposed tall tower to which attention is directed in an article elsewhere in this issue, it is evident that electricity is depended upon also for its assistance in spectacular effect.

A few years ago there was a decided prejudice against office or residential apartments under the roof in what were the tall buildings of those days, but now no discrimination exists against the top floors. On the contrary, their superior light and airiness, their ready accessibility by swift elevators, and their remoteness from the noise and dust of the street, make them desirable in winter as well as in summer. In such a city as New York, to-day, a large proportion of the people live and work and go to the theater at a height of 100 feet in the air, and their number is decidedly on the increase. Now that the church steeples are having their diminished heads hidden by the overtopping office structures and apartment houses, we may see the churches also resume their conspicuous place by becoming a part of the city in the clouds. The future for electric elevators under these changing conditions is obviously a bright one.

MUNICIPAL TAXES AND WASTE.

AT a time when one hears so much about the saving to be effected by municipal plants and the municipal management of various enterprises, it is well to remember that the evidence is almost wholly the other way. As we have before pointed out, it is a question of fact; and if the municipalities can work cheaply the thing is settled, so far as any individual case is concerned. So long as the record of municipal work is one of high taxation and terrible extravagance in the majority of places, it certainly is absurd for some economists to infer as they do that the alleged success of one or two city plants is enough to offset the teachings of a grim experience.

San Francisco, for example, has had advocates of a municipal plant, but at the present moment the burden of taxation is frightful. In San Francisco the tax rate reached, last year, $2.35 on the $100, and many owners of business property actually saw four months' rent absorbed by taxes. This excessive tax was due to criminal waste in the various municipal offices, which experts have estimated at $2,000,000 a year. And yet it is the opinion of some persons that rates should be raised even higher so that there should be more money to waste. The outcry in San Francisco has been so strong that the tax rate during the current year will probably be $1.60 on the $100, which in itself is high enough, on any consideration. It will be a long time, we should think, before any San Franciscan will want to entrust any more business to municipal management that he can carry out under the economies of private enterprise.

THE NEW FRENCH ATLANTIC CABLE.

IT might have been thought that there were enough Atlantic cables to take care of the traffic now offering, and it has often been assumed that there would be no early addition to the number. But the French Government has now given powerful support to the latest plan for another cable from Brest to Cape Cod, as already noted in these columns, and as a spirit of patriotic independence appears to be at the bottom of the enterprise, we see cause for expecting that presently Emperor William will also be wanting an exclusive German cable starting from some point on the coast of the Fatherland and running directly to these shores. The sentiment at the back of the French scheme in not concealed. The cable is to be manufactured entirely on the soil of France; it is to be laid by Frenchmen and at least one of the laying ships is to be French; it is to be managed by Frenchmen, and the French Government has guaranteed a substantial subsidy of $160,000 a year for no less than thirty years.

It is, of course, to be understood that this cable will be owned and operated by the Compagnie Francaise des Cables Telegraphiques, to which belongs the existing "P-Q" (Pouyer-Quertier) cable, and that it will link into the West Indian and South American cables under French and Dutch control. The gross estimated revenue of the system is $500,000, and as there is no appreciable new source of income of that amount, it is likely that other lines may suffer and that a new cutting of cable rates may ensue. The cable is to be working by next year, by which time perhaps an improvement in business may come to relieve the competitive tension.

DETROIT CHEAP FARES.

THE fact that the Detroit Citizens' Road had lost $80,000 in receipts during the present year, as a result of its 3-cent fares, is sufficient explanation for the adoption of a higher rate, as announced in our columns this week. Detroit has been the scene of a cheap fare experiment that has deeply interested the street railway community and the result appears to be sheer failure. One manager in a large city said at the time that the 3-cent rate would wipe out the capital of his company in about ten years, and that is certainly the fate that began to stare the Detroit managers in the face. It is to be hoped that the incident will have its lesson in other places where the agitation has been taken up. As a matter of fact, the only reasonable alternative offering to the flat 5-cent fare is the European plan of charging a cumulative fare by a punched ticket system. That has its disadvantages, and it is undeniable that the American can ride further and better for a nickel than can other people elsewhere.

One point worth noticing is that lower fares do not seem to have greatly stimulated travel, and the inference is that the travel to be won by cutting the fare one cent or even two is often a negligible quantity. More travel is to be secured by keeping up the fare and by providing special features of comfort and convenience, as well as maintaining the road in good physical condition.

AN ALLEGED TELEPHONIC-TELEGRAPHIC COMBINATION.

NOTE is made in our pages this week of another "consummation" of the deal that has been so long coming off between the Western Union Telegraph and the American Bell Telephone Companies. It is alleged that the Western Union has absorbed the telephone entirely, which even if true, is a little surprising. Meantime, those most concerned have little to say on the subject. Denial is piled on denial, but only in an end-of-the-summer, languid kind of way. Vice-President Van Horne, of the Western Union, knows of no such arrangement, while Treasurer Driver, of the American Bell, is ready neither to affirm nor contradict. The old contract runs out in November, so that a new arrangement would certainly be timely if it has not already been made these many months.

TELEPHONY AND TELEGRAPHY.

RUMORED CONSOLIDATION OF WESTERN UNION AND AMERICAN BELL.

With regard to the reports and rumors in circulation of late as to the news terms between the Western Union and American Bell Companies, the following appears in the Boston "Commercial-Bulletin:"

"We understand upon the best authority that the Western Union Telegraph Company controls at the present moment the American Bell Telephone Company. The importance of such control will at once appear to every one who appreciates how the two have come in competition during recent years. The Western Union dividends had become threatened through the competition of the Bell company and of the Postal Telegraph Company, but it has long been a fully arranged plan for the Western Union to secure control of the telephone company. The two together can probably make it very warm for the Postal Telegraph Company, or the final outcome may be a combination of all three.

"Mr. J. Pierpont Morgan has been the largest purchaser of Bell Telephone stock at auction here, but the manner of purchase has been very cleverly concealed. Western Union stock has ruled weak on the New York Stock Exchange during the past few days, but this weakness is thought to be part of the programme of those conducting this gigantic deal. The combination of these two concerns will mean an almost impregnable monoply of both the telegraph and telephone business in the same hands."

The Western Union Company is capitalized at $100,000,000 and the American Bell Telephone Company at about one-half that amount. In 1893 the capital was $17,500,000, and was then increased to $20,000,000. In the following year it was increased to $50,000,000, and the issue of $1,000,000 additional stock was authorized in June, 1895. The stock is quoted at about 200. Western Union, at its closing price on Aug. 21 of 73⅝, was worth $73,625,000, while American Bell at 200 was worth $100,000,000.

A SUIT TO KEEP UP TELEGRAPHERS' SALARIES.

The telegraph operators on the line of the Union Pacific have filed a suit in the Federal Court at Omaha. The case is brought in the name of the Order of Railway Telegraphers. The plaintiffs allege that the receivers have reduced wages in violation of Judge Caldwell's order of 1894, wherein the court ruled that no cut in wages could be enforced without an order of the court. They specify where wages have been cut, and ask to have them restored. It is further alleged that the officials of the company are hostile to organized labor, and particularly to the Order of Railway Telegraphers, and that a systematic effort has been made to weed out leaders of the order by summary dismissal without excuse.

TELEPHONE WORKMEN KILLED BY DYNAMITE.

For some time past workmen have been employed in rebuilding the Pennsylvania Telephone Company's line between Lancaster and New Holland. The new poles are being set 5 feet deep and the holes for them were being blasted out with dynamite, of which about 250 pounds had been received some days before the accident. At the time of the explosion there was from 50 to 100 pounds on hand which had been stored in a summer kitchen of the Eagle Hotel at New Holland. The explosion occurred in the morning just after the foreman had given orders to have the dynamite placed on the construction wagon where it was generally carried under the back seat. Just how the accident occurred will never be known, for Cannon, the one man who could have told everything, was blown to pieces. When the explosion occurred the driver of the team, F. Hammond, had just taken his seat on the 'bus and was about driving out into the yard from under the shed.

Out of the nineteen workmen employed on this job three were killed outright and thirteen were injured.

So tremendous was the force of the explosion that the stable, wagon shed and summer kitchen were blown to pieces. The hotel was badly damaged, looking inside as though a tornado had passed through it, and every building within two blocks of the hotel, which is in the heart of the town, had its windows knocked to pieces. In many instances, the sashes themselves and doors were blown out. Every sash and door in the hotel was blown out, and the furniture itself is badly damaged, entailing a total loss of $5,000. A singular fact is that an unexploded box of dynamite was afterward found in the ruins of the shed where it had been placed beside the box that exploded.

WESTERN UNION WIRES IN SYRACUSE, N. Y.

Work is now being actively carried on in putting the Western Union wires underground in the city of Syracuse, N. Y. The cables have been supplied by the Standard Underground Cable Company, of Pittsburg, and the work is in charge of Mr. Edward Sullivan, of their staff. Wooden duct subways had already been laid. The city retains the right to use the Western Union subway for police and fire alarm service, and these wires are also soon to be removed from the poles.

ROENTGEN RAYS.

ROENTGEN RAYS IN MEDICAL RESEARCH.

There was recently at the new Animals Institute, London, a private view of some exhibits for a competition in improvements in the Röntgen rays to aid in the diagnosis of lameness and disease in the human subject or the lower animals. The Institute is at present offering gold medals for the best photographs of the internal frame that assist in the diagnosis of disease, and the competitors include medical men, scientific institutions, and also photographers. A good number of photographs of diseased parts has been collected, but the competition will remain open for some time longer. The fifth quinquennial gathering of the International Homœopathic Medical Congress was held last week in London. On the opening night, Dr. Gerard Smith gave a display of Röntgen photography and other novelties.

REPORTS OF COMPANIES.

AFFAIRS OF ARCHER & PANCOAST CO.

The Archer & Pancoast Company, manufacturers of gas and electric light fixtures, whose salesrooms are at Nos. 18 and 20 West Twenty-fifth street, this city, and which has a factory at Flushing and Carlton avenues, Brooklyn, went into the hands of receivers, on August 19. Justice Smyth, of the Supreme Court appointed Albert C. Hetherington, William S. Fearing and Peter F. Meyer receivers, with a bond of $100,000, on the application of President Pancoast and other directors of the company. Mr. Fearing is vice-president and general manager, Paul Thompson, treasurer, and Mr. Hetherington a director. Thomas B. Odell was appointed referee, and the order to show cause for the dissolution was set down for February 5, 1897.

It was said by the officers that the company was insolvent, that it had recently found it impossible to obtain money in any considerable quantity, owing to the financial stringency all over the United States, and that within the last week the bank with which the company had always done business had refused further to extend its line of discount. To save the assets from slaughter and make the best possible disposition of the property, the officers deemed it best to apply for receivers. The total liabilities are $806,780, and the nominal assets $821,063. Of the liabilities, $705,017 are mortgage liens on all the property of the company, except accounts receivable. These mortgages are for purchase money of factory, $55,000; to secure notes, $267,482, and to secure income bonds, $378,465. There is due for merchandise $51,025 and for loans by stockholders $37,074.

The assets consist of real estate and factory in Brooklyn, $200,000; machinery, etc., $201,552; models, patterns, etc., $100,000; merchandise, $139,037; improvements at factory, $17,844; store fixtures, $12,000; goods in New York store, $37,067; stock of other companies, $11,000; accounts receivable, $102,563. Of the accounts, $18,000 are probably uncollectable, and $14,414 have been pledged to secure advances. The officers believe that there will be no equity in the assets which are covered by the mortgage liens leaving only the accounts to pay the unsecured debts. The company did not have any rating at Bradstreet's. It is a reorganization of the old Archer & Pancoast Manufacturing Company, which went into the hands of receivers on May, 1893, with liabilities of $1,100,000. The property was sold to the Reorganization Committee for $600,000, and the present company was formed by the creditors in November, 1894, to carry on the business. About 400 persons were employed by the company.

THE OHIOPYLE FALLS of the Youghiogheny River are the latest to receive the attention of the power transmission promoter. Mr. D. S. Stewart, of Ohiopyle, Pa., owner of large property in the neighborhood, is interested.

ELECTRIC HEATING.—It is stated that the stock of the American Electric Heating Corporation is about to be listed on the Boston Stock Exchange.

Electric Lighting.

ELECTRIC LIGHTING IN BELFAST.—II.

BY VICTOR A. H. MC COWEN.

Concluded.

In the high-speed four-cylinder engines the compressed air connection is made to the bottom right-hand cylinder, which for starting purposes is specially provided, firstly, with a valve to close the mixture admission port, secondly, with an exhaust passage and a valve to close it, and thirdly with an inlet for the compressed air. The valve of this inlet is worked by a double-throw cam, thus giving an impulse for every revolution in this cylinder. The speed increases quickly, and as soon as the explosions take place in the other cylinders, the compressed air is shut off, the starting cam thrown out of action, and the gas turned on to this cylinder.

Mains, Feeders, and Distributors.—These are mostly bare copper strip in concrete culverts. The strip is simply supported on earthenware insulators placed 6 feet apart, which are held in place by a pitch setting. The strip is laid in before the cover flags are put down; and extra copper can be drawn in at any time without raising the flags. Everywhere the culvert is placed beneath the footway. The lengths average 25 yards, and are built with a fall towards the junction boxes in order to allow any water that may get in to drain off. The average depth of the copper below the surface is 20 inches. The space required for a three-way culvert for a distributing main is 27 inches wide, with a minimum depth of 18 inches below the surface. For a five-way culvert, which takes the distributing mains and a pair of feeders, the space required is 34 inches wide, with a depth of 18 inches.

TABLE 1.—Test of No. 6 Tandem Engine and Dynamo. Taken April 24, 1896.

No. of test	I.	II.	III.	IV.	V.	VI.
Duration of test, min	30.0	30.0	30.0	30.0	30.0	15.0
Load factor, per cent	120.0	100.8	74.8	52.3	25.2	exciting.
Mean speed per min., revs	166.5	167.5	168.0	166.0	168.0	167.0
Mean amperes	285.7	241.5	179.4	125.2	60.2	....
Mean volts	240.9	240.2	240.0	240.1	240.0	240.0
Mean kilowatts	68.8	58.1	43.1	30.1	14.5	....
Mean E. H. P.	92.35	77.9	57.8	40.3	19.4	....
Mean I. H. P.	120.5	101.4	80.2	64.4	45.0	....
Kilowatt hours	34.4	29.0	21.7	15.01	7.25	....
E. H. P. hours	46.1	39.0	28.9	20.2	9.7	....
I. H. P. hours	60.25	50.70	40.10	32.20	22.50	....
E. H. P. ÷ I. H. P., per cent	76.6	76.8	71.8	62.7	43.2	....
Gas used:						
Excl. ignition, cubic feet	1,247.0	1,115.0	1,010.0	953.0	874.0	349.0
Incl. " " "	1,260.5	1,129.3	1,024.2	968.1	888.3	401.4
Pressure, inch	1	1	⅞	1	1	1
Total cubic feet, per hr	2,521.0	2,258.6	2,048.4	1,936.2	1,776.6	1,605.6
Excl. ignition, per k. w. hr.	36.3	38.5	46.5	63.7	120.5	....
" " per E. H. P. hr.	27.1	28.6	35.0	47.5	90.1	....
" " per I. H. P. hr.	20.7	22.0	25.2	29.6	38.8	....
Incl. " per k. w. hr.	36.6	39.0	47.6	64.3	122.6	....
" " per E. H. P. hr.	27.4	29.0	35.5	48.0	91.7	....
" " per I. H. P. hr.	20.9	22.3	25.6	30.1	39.2	....
Water used, tank temp. F.	85.5°	84.5°	84.0°	86.0°	83.5°	....
Temp. of jacket-water leaving jacket, F	110°	108.4°	131.7°	106.0°	112.0°	95.5°
Water used, lbs	10,915	6,550.0	11,280	6,360.0	6,375.0	5,650.0
" " lbs. per k. w. hr.	317.5	226.0	520.0	423.0	880.0	....
" " lbs. per E. H. P. hr.	237.0	168.0	391.0	314.0	657.0	....
" " lbs. per I. H. P. hr.	181.0	129.0	282.0	197.0	283.0	....

Culverts.—Three-way and five-way culverts are built of cement concrete in the proportion of five of gravel and broken stones to one of Portland cement. The side walls are 6 inches thick, and the bottom 4 inches, all faced inside with cement. The covering slabs are 2-inch Kilrush and Caithness flags. The culvert when dry is itself a fair insulator, which is a great advantage where there is a possibility of sometimes getting a sag of the strip between the insulators, as may occur through the carelessness of workmen. At street crossings, and under narrow footways where there is no room for a culvert, insulated cables in cast-iron pipes are used. Connections between the lengths of strip, or between cable and strip, are made in the street boxes by means of gun-metal grip-boxes, which clamp the ends together.

The copper strip is 1 inch wide and 0.2 inch thick, giving 0.2 square inch section. This is the section used in all the distributing mains, both for middle and outer wires. When the lamp density—that is, the number of lamps per yard—increases, the section of the outer wires can be increased by putting in another strip on the top of the present. The section of the feeders varies from 0.4 to 0.8 square inch, according to the length; the longest feeder at present is 520 yards.

The distributing mains are all in parallel, and are connected at as many points as possible in order to equalize the pressure. They are brought back to the station to supply current for the lighting, etc. The middle wire is brought back from four different points of the network. The pilot wires are in the form of three separately insulated conductors, twisted together and cased in lead; some have paper insulation and others impregnated jute. The joints are protected, either by a lead sleeve soldered to the lead covering and filled with insulating oil, or by being placed in a special joint-box, which is filled with insulating material run in hot. The pilot wires are drawn into cast-iron pipes laid along one side of the culvert.

On account of the wet nature of the ground and the comparatively low level of the city, special precautions had to be taken against water getting into the culverts or accumulating in them; and the aim has been to make the whole watertight. The street boxes are built of brick, faced inside with cement, and the bottoms are concreted. They are provided with a cast-iron frame and cover, the latter being filled with concrete. A water-tight joint is made between cover and frame by the use of House's slow-setting cement. Junction-boxes placed in the roadway are provided with specially heavy frames and covers, the latter being filled in with wood blocks. The covers are provided with inspection plugs, which allow of a rapid examination of the system being made without lifting the covers. Any accumulation of water can be removed through the inspection-plug hole by means of a small hand-pump. A record is kept of the condition of the boxes, and of the dates of their having been pumped out. The covers are also lifted periodically for the ventilation of the culverts. No trouble has been experienced from gas accumulating in the culverts. At the laying of the mains all defective gas services were renewed, and those that ran close to the culvert were coated with a mixture of pitch and tar.

TABLE 2.—Tests of No. 2 Single Cylinder Double-Acting Engine. Taken June 5 and 6, 1896.

No. of test	I.	II.	III.	IV.	V.	VI.	VII.
Duration of test, min.	30.0	30.0	30.0	30.0	30.0	30.0	15.0
Load factor, per cent	117.8	99.3	75.8	53.6	23.85	50.6	23.85
Mean speed, per min., revs.	160.3	162.0	160.5	163.0	160.0	161.0	163.0
Mean amperes	214.8	183.0	138.8	96.3	44.3	55.0	43.8
Mean volts	144.7	143.0	143.7	147.0	141.8	242.4	144.4
Mean kilowatts	31.1	26.2	20.0	14.15	6.3	13.35	6.3
Mean E. H. P.	41.7	35.1	26.8	19.0	8.45	17.9	8.45
Mean I. H. P.	57.6	48.8	43.96	33.2	23.8	29.8	22.3
Kilowatt hours	15.5	13.1	10.0	7.07	3.15	6.67	1.5
E. H. P. hours	20.8	17.5	13.4	9.5	4.22	8.9	2.11
I. H. P. hours	28.8	24.4	21.53	16.6	11.9	14.9	5 9
E. H. P. ÷ I. H. P., %	72.2	71.8	62.3	57.3	35.5	60.1	37.9
Gas used:							
Excl. ignition, cu. ft	604.0	540.0	495.0	485.0	448.0	317.0	133.0
Incl. " "	610.6	546.5	501.2	491 7	454.3	323.9	136.9
Total per hour, "	1,221.2	1,093.0	1,002.4	983.4	908.6	647.8	547.6
Excl. ignition, per k. w. hr	38.9	41.2	49.5	68.5	142.0	47.5	84.5
" " per E.H.P. hr	29.0	30.4	36.9	51.0	106.0	35.4	63.0
" " per I.H.P. hr	21.0	22.1	23.0	29.2	37.6	21.27	23.9
Incl. ignition, per k. w. hr	39.4	41.8	50.1	69.4	144.0	48.5	87.0
" " per E.H.P. hr	29.4	31.2	37.4	51.7	107.0	36.2	64.8
" " per I.H.P. hr	21.2	22.4	23.3	29.6	38.2	21.72	24 5
Water used:							
During test, lbs.	....	....	1,805.0	1,940.0	....	1,940.0	....
Per hr., lbs.	....	....	3,610.0	3,880.0	....	3,880.0	....
Per k. w. hr., lbs.	....	....	180.0	274.0	....	290.0	....
Per E. H. P. hr., lbs	....	....	134.0	204.0	....	217.0	....
Per I. H. P. hr., lbs.	....	....	84.0	117.0	....	130.0	....

Note.—In tests I. to V. both ends of the cylinder were working, no explosions being missed. In tests VI. and VII. one end only of the cylinder was working.

The service mains are rubber-covered cables drawn into wrought-iron pipes, which are laid from the nearest street-box. They are connected to the corporation-main fuses immediately inside the building. The connections to the distributing mains are clamped in the case of bare copper strip, and insulated T-joints are employed for connecting to cable.

Throughout the system the positive and negative mains have certain relative positions under the foot-way, namely, the negative main or feeder is everywhere next the curb and the positive next the houses. In the street-boxes the positives are colored blue, the negatives red, and the middle wire black; the service cables are colored in the same way.

General Remarks.—From the experience here gained the author is of opinion that a gas-engine station necessitates more attention than a steam-driven station; and more drivers of a better class are required for a given power than in the latter station. A couple of men are always required for the electrical

starting of an engine. Without their help the strain on the armature would be too great, if the current were switched on when the machine was standing.

The following statement shows the cost of current sold from January 23 to December 31, 1895:

Number of units sold	82,771
Number of lamps connected (equivalent in 8c. p. s.)	10,500
Revenue from sale of current	£2,186
Average price obtained per unit	6.34d

	Cost of Production. £	s.	d.	Per unit Sold. d.
Fuel (Gas)	501	3	0	1.450
Oil, waste, water, and stores, including ignition tubes	80	4	3	0.233
Salaries and wages at generating station	444	17	4	1.290
Repairs and maintenance of buildings, engines, dynamos, and accumulators	93	16	8	0.272
Repairs and maintenance of mains	76	4	6	0.221
Rents, rates and taxes	236	0	0	0.684
Management expenses, etc.	413	9	11	1.200
Insurance	23	2	0	0.07
Total	£1,868	17	8	5.42

A machine can be started up and got on circuit in about two minutes, the stand-by units being kept plugged up on the switchboard and the ignition tubes kept hot. For the sake of efficiency the machines are run as near to full load as possible, but, as far as governing is concerned, they can be run at any part of their load. The cost of fuel (gas) per Board of Trade unit sold for the year ending December 31, 1895, worked out at 1.45d. This, with gas at 2s. 3d. per 1,000 cubic feet, is equivalent to 53.6 cubic feet per unit sold, or 59 feet per unit generated. The total efficiency of units sold to generated is 91 per cent. This is equal to an average consumption during the year of 44 cubic feet of gas per E.H.P. hour. A plotted curve showing the cost of gas per unit of electricity, generated and sold, throughout the year proves that it varies very little, whatever the output may be. The cost of engine-room stores, including oil, waste, water and ignition tubes, amounts to 0.23d. per unit sold, which compares favorably with steam-driven stations. Ignition tubes form a heavy item of the cost. Good results are now being obtained with porcelain tubes, which require only a short time to heat up. The cost of cooling water works out at a low figure, and this is due to the use of a tank of large capacity, which has special cooling arrangements.

The station started to supply current on January 23, 1895, with 2,300 8 candle-power lamps; there are now 13,500 lamps of 8 candle-power connected with the mains.

The following statement shows the quantity of units of electricity generated, sold, etc., from January 23, 1895, to December 31, 1895:

Quantity sold:—

Public lamps.

	Units.	Units.
Private consumers by meter, at 4d. per unit	574	
Private consumers by meter, at 7d. per unit	82,197	
		82,771
Quantity used on works	3,822	
Quantity lost in battery	6,304	
		10,126
Total quantity accounted for		92,897
Quantity not accounted for		2,229
Total units generated		95,126

From this it will be seen that:—

	Per cent.
Total efficiency	= 91.0
Loss in batteries	= 6.7
Loss in main	= 2.3
	100.0

The total maximum supply demanded was 159,000 watts, which is equivalent to 5,300 30-watt lamps.

A STATE LIGHTING PLANT FOR FRANKFORT, KY.

A special dispatch from Frankfort, Ky., says: It has been about definitely decided by the Sinking Fund Commissioners to carry out a supposedly economic enterprise by which the State will light its own public buildings, offices and the public square, and unless present intentions are changed a big electric light plant, to be operated by a trained engineer with the assistance of prisoners, will be placed in the penitentiary, while the wires will be run in to the public buildings and grounds. It is claimed that the State, which uses a great deal of light, will save much on gas and electric light bills by this means, and that the original cost of the plant will soon be more than saved.

The local Gas and Electric Light Company is supposed to have exclusive privileges in Frankfort, and it does not seem to have occurred to the State officials that this company may complain to the council and object to the council's permitting the poles and wires of any other lighting concern being run through any of the streets of the city.

SILVERED INCANDESCENT LAMPS.

Our London contemporary, the "Electrical Review," devotes considerable space to an incandescent lamp which is being introduced by the Improved Electric Glow Lamp Company, Limited. The lamp in question differs from the style generally seen in being about twice the size in diameter, and very much flattened in length, so that the upper surface of the glass which spreads out from the base is in the form of a small oval shade. This upper part of the bulb is silvered or gilded so as to form a reflector which answers the same purpose as the shades in ordinary use. The silvering is varnished over on the outside of the bulb and only the lower half of the lamp remains transparent.

Another point of interest in connection with this lamp is that the filament is placed symmetrically with respect to the silvered surface, or, in other words, as nearly as possible in the optical focus of the mirror. The claim for these lamps is that they give a maximum light on the surface to be illuminated with the least expenditure of energy.

The silver plating on the glass is electrically coated on the outside with copper, and afterwards varnished. The silver plating is thus protected from the direct action of external heat and air, and is said to keep perfectly bright after some thousand hours of lighting. The latter statement, we believe, must be taken cum grano salis, as, unless the efficiency of the lamp is much less than it is said to be, the filament would probably be burnt out considerably under one thousand hours, and the inevitable blackening of the bulb must affect the mirror to some extent long before the lamp is burnt out.

The light from these lamps can be intensified several times in any given direction by the concentration of the direct and reflected light upon a limited area, and one of the special features is the use of this lamp for throwing the light on the ceiling, and thus lighting rooms, etc., with a very soft and diffused light, very pleasant to the user. As far as the silvering of the bulb alone is concerned there is nothing whatever new about it as lamps of the ordinary shape have been silvered for several years by a number of companies; but in regard to the shape of the bulb and the placing of the filament co-axially with it, we should judge these modifications might be of considerable advantage to the lamp for certain purposes. The company report contracts in hand for a very large number of these new lamps, and while their claims for them are certainly extravagant, it is probable, from the testimony of those who have seen them, that these lamps have considerable merit. The claim, however, that a 10 c. p. new lamp gives 25 per cent. more light than an Edison-Swan lamp, and uses 46 per cent. less current than the latter, is certainly in need of further investigation, and undoubtedly, modification.

ICE AND ELECTRIC PLANT AT OSCEOLA, ARK.

Mr. G. N. Borde, of the Electrical Engineering and Supply Company, Memphis, Tenn., informs us that they are installing at Osceola, Ark., a combination ice and electric plant. It comprises a Remington 2-ton ice machine, complete; a 50 horsepower Houston, Stanwood & Gamble engine and 60 horsepower boiler; a Thomson-Houston 500-light self-exciting alternator, and all the fixtures, wiring, etc., for street and private lighting. The building is 32 by 40, of corrugated iron. The water supply is furnished by a Cook deep-well pump putting water into a 3,000-gallon iron tank. The plant is in every respect suitable for a small country town of 2,000 inhabitants, and costs complete about $7,500.

PLANT PROPOSED FOR CUTHBERT, GA.

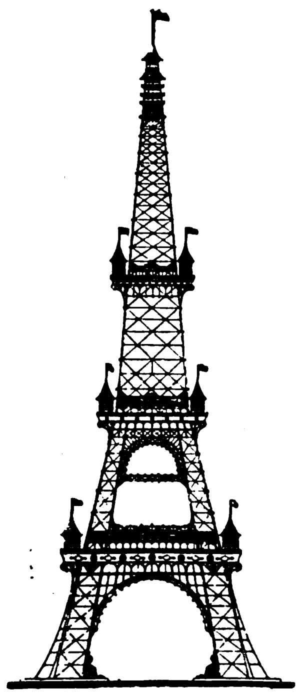
Mr. Robert L. Moye, the mayor of Cuthbert, Ga., informs us that the mayor and council of that city have ordered an election September 18, to determine whether the town shall issue $7,000 in bonds to establish an electric light plant. He says that everything looks encouraging for a favorable vote, with little or no opposition.

News and Notes.

CHICAGO'S CITY TOWER.

A tower has been projected and is in actual course of exploitation in Chicago, which is to be 1,115 feet in height, and whose estimated cost is $800,000. The base of the tower, which will occupy an entire city block is to be 326 feet square.

At the base, from the four corner supports, each of which is 50 feet square, will rise arches 200 feet across and the same in



Proposed Electric Tower for Chicago.

height. These arches will support the first landing, which will have 90,000 square feet of flooring, where 22,000 persons can be accommodated at one time. There is a distance of 225 feet from the ground to this first landing.

At a height of 450 feet there is to be a platform 150 feet square. Six hundred and seventy-five feet above the ground is the third landing, far higher than any building in Chicago. At an elevation of 1,000 feet above the earth is the fourth landing, and from there stairs lead up to the very top of the tower.

Thirty-four elevators are to be used in this tower. They will be operated by electricity, the power being derived from the same plant used in lighting the structure.

The plan of having a United States meteorological bureau has been discussed at Washington and favorably considered by the officials of that department. The most important observations of all on such a tower would be those relating to atmospheric electricity. A few observations at the Washington monument have already shown some remarkable comparisons between the changes at that height and at the earth's surface. There is hardly a point regarding diurnal change, abnormal change or seasonable change of meteorological element that would not be successfully aided by records from such a tower.

SHORT TALKS ON BEARINGS, ETC.

BY M. W. DANIELSON.

ONE of the best kinds of bearings that I have ever had to do with, one giving the least trouble and requiring the least looking after, is the kind with a hollow space under the babbited box, forming an oil well, as shown in Fig. 1.

A mechanic can fix old bearings in this way, if the boxes are of the right kind. Cut a hole in the bottom half of the sleeve at D, and rivet on a piece of brass so as to form the well,C. Solder up the crevices. Put in an oil feed tube at one side so as to fill the well at intervals.

When the shaft is running, the oil will be fed to the shaft, A, by a wick which comes in contact with the shaft by being pushed through a hole in the bottom half (B) of the box and left to hang down into the oil in the well, as shown; this kind of a bearing will run for two months on one filling of the well, and as long as oil is kept in the well there is no danger of the bearings getting hot for want of oil. The wick will feed the oil to the shaft as fast as needed and no faster.

I have recently been troubled with a shaft in which there was a bend, as shown at F, Fig. 2, and this bend frequently made trouble all along the line of shafting. This was repaired one Saturday night without taking it from the hangers, by adopting the plan used to straighten bent files.

First, I set up a post, H, just beneath the bend in the shaft, E, and nailed a pan, G, on top of it. Then I places hot coals in the pan and heated the shaft; afterwards while cooling, pressure was applied to the shaft with chains and weights, which brought it back into line. Shafting will always get out of line if too light for the work put upon it.

There are weak spots in shafting, as well as in everything; "a chain is no stronger than its weakest link," and so with a shaft, its weak spots receive the strain and give way to it until it becomes out of true, and no amount of aligning will make it run true. It is no uncommon thing in mills to find shafting too light for the amount of work required of it.

Referring to another point, I will mention a case in which the backlash of the shaft was severe and as there was no space for another journal at the end of the shaft, I tried the plan shown in Fig. 3, with good results.

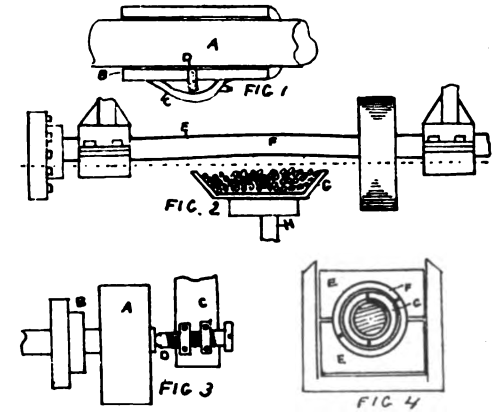
A is a pulley which fitted close to the end of the shaft, as shown. The coupling, B, prevented putting a hanger on the inner side and there was no room further along. I cut a ½-inch hole in the end of the shaft and inserted the pin, D, in it, and supported this pin firmly in place in the casing, C. This served to steady the shaft. If shell rolls are in use, two of a different size will not run together well. All shells should be callipered and put in the right way. Shell rolls are not often used, but we represent a set in Fig. 4, in which the wood casings are marked E E and the shells F G. It can be readily seen that if either of the shells are untrue or mismated that they will not do good service.

Good bearing for machinery is the hard steel ball bearings, which are being run on some makes of machinery with excellent results, greatly reducing the friction on the bearings, and also the danger of cutting in case it should get dry. In setting roller systems there is one precaution to observe. There is a small saddle resting on the middle and back rolls, having a long and a short side. The long side should rest on the middle roll and not the reverse. When this is done, the most weight is on the middle roll, leaving the back roll with very little weight.

Piston Packing.—The variety of methods of packing employed are many. The utility of packing depends, first of all, upon the cylinder, and the care which has been exercised in its construction.

The important thing is to get a cylinder absolutely true and smooth. If this has been accomplished, the matter of packing is relatively unimportant.

If it is necessary to bore, provide a system of boring the cylinder which performs the work with so little labor on the part of any one tool that its cutting edge does not become dulled during the whole process, and with the expenditure of so little



Short Talks on Bearings.

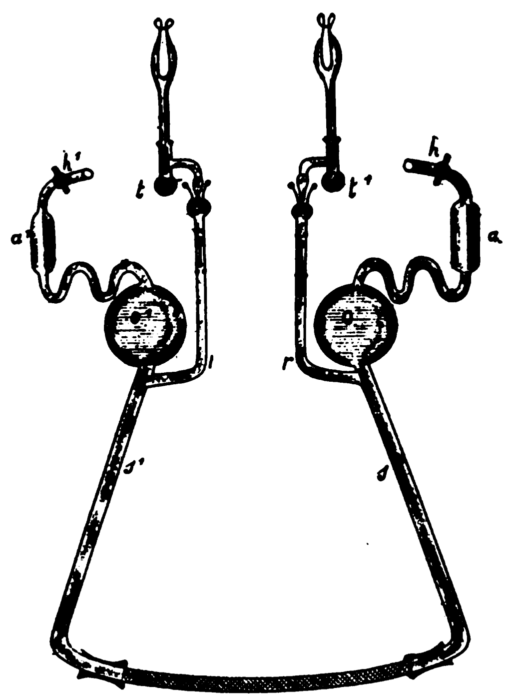
time that no accident is liable to occur from unavoidable stopping of the power.

The process of boring is best performed with the cylinder standing upon its seat, in the position which it will occupy when in actual operation, so that any distortions in the metal, due to the weights of the various parts, however trifling they may be, will have the same effect during the process of boring as they will when the engine is set to work.

DOUBLE ACTING MERCURY AIR PUMP.

THE mercury pump described below was constructed by W. Bähr and E. A. Krüger, of Berlin. Its chief feature is that it operates twice as fast as the ordinary hand pumps.

As shown in the illustration, taken from the "Elektrot. Anzeig.," two Töpler pumps whose riser tubes, s s', were only 40 cms. long, were conected by a rubber tube at their lower ends



DOUBLE ACTING MERCURY AIR-PUMP.

so as to communicate with each other. The pump was mounted on a board so that the bulbs, o' o, were in the position shown.

The usual barometric tube is dispensed with and immediately above the air accumulators, a' a, there is placed a glass cock; no other change is made in the pump. The board on which the pump is mounted is arranged so that it can turn upon a central horizontal axis, the motion on each side being limited by stops.

The pump is supplied with mercury until the bulbs, o o', are filled about one half; the two cocks, h h', are connected to a preliminary pump. The vessel to be exhausted is connected to the drying bulbs, t t', and the preliminary pump set in action; by opening the cocks, h h', the greater quantity of air is removed. Since the air is removed from both sides, the level of the mercury remains constant.

If now the board be turned on its axis, a difference in level ensues, the mercury in the bulb, o, falls below the tube, r', connecting with the vessel to be exhausted, while on the other side it forces the air through the accumulator a', where it is removed by the preliminary pump. On turning the board in the opposite direction the same action is repeated, the mercury now falling in o', and rising in o. The air is prevented from rushing back by the action of the bent capillary tubes, which retain the mercury. The oscillation of the board is continued until the mercury in the bulb touches the mercury thread in the M-shaped capillary tube; that is, until it shows no air space between them.

It will be noticed that with this combination one pump alternately serves as the mercury reservoir for the other; by this means its movement is fully utilized. With ordinary pumps the falling of the mercury must always be awaited before a fresh exhaustion can take place.

According to the designers the pump operates faultlessly and as the oscillation is a slow one, breakage is almost completely prevented. The pump is not patented or legally protected in any way.

NEW CENTRAL STATION AT ATHENS, MICH.

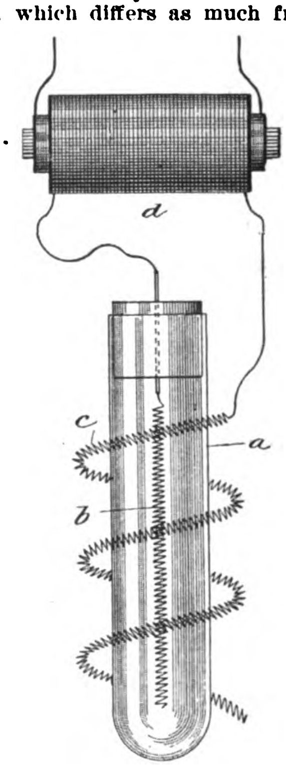
The new central station installed at Athens, Mich., by Rheubottom & Bond, of Union City, Mich., has been put in successful operation and turned over to the Athens Electric Company. The dynamos were furnished by the United Electric Improvement Company, of Philadelphia, the transformers by the Wagner Electric Manufacturing Company, of St. Louis, and the copper wire by the Phillips Insulated Wire Company, of Pawtucket, R. I.

ANDREOLI APPARATUS FOR PRODUCING OZONE.

A METHOD of producing ozone by means of the silent discharges generated by an electric current from points, sharp angles, etc., has been known for several years, and this method has recently been improved by Emile Andreoli, of London, so that ozone and light are produced simultaneously. This is effected by the use of points or sharp angles like the serrated wires shown in the illustration, in connection with tubes containing more or less rarefied gases. The method will be explained by reference to the accompanying drawing which is somewhat diagrammatical.

The tube a is provided inside with an electrode b, consisting of a carbon filament or a metallic wire or rod, or a bundle of small serrated wire, the points of which radiate, so as to face the inside of the glass tube. Outside the tube, and in proximity to it, as shown, some serrated wires, c are fixed. One end of the wire rod b contained in the vacuum-tube is connected with one of the poles of a Ruhmkorff coil d, or of a high-frequency transformer. The external metallic electrode c of the tube is connected with the other pole, and as soon as the electric current passes the inside of the tube becomes luminous, and at the same time on each of the points of the serrated wires, the characteristic glow of the silent discharge appears and is accompanied by a strong smell of ozone.

It is a well-known fact that the silent discharge produces a bluish or violet glow; but there is another luminosity here quite distinct from the glow generated by the silent discharge. In the vacuum-tubes there are both the glow of the silent discharge outside, and luminosity inside. This is scientifically a new phenomenon which differs as much from the disruptive



ANDREOLI'S OZONIZER.

discharge in ordinary vacuum-tubes as the internal luminosity of the tubes differs from their external glow, and it is believed that nothing similar has ever been produced before.

THE OELSCHLAGER-SCHROTTKE LIGHTNING ARRESTER.

WE illustrate herewith a new lightning arrester invented by Messrs. Oelschlager and Schrottke, of Germany. The device consists of two parallel stationary uprights, which are placed within arcing distance for a portion of their length, having their upper ends widely diverging and their lower ends, which are insulated from each other, connected respectively with the circuit and the ground.

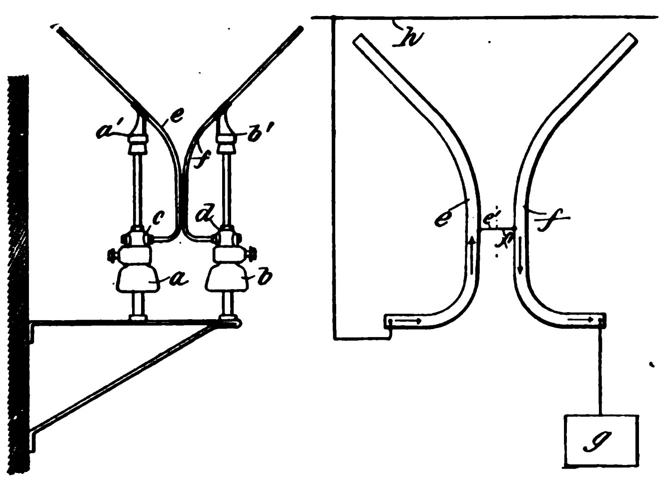
Fig. 1 gives a general view of this lightning arrester and Fig. 2 shows the parts diagrammatically. The metallic caps e and d, which support the lower ends of the uprights e f, are

secured to the insulators a b. These caps are connected respectively to the circuit and to the ground. Within these caps the uprights are adjustable so that the distance between them may be varied according to the voltage of the circuit which the arrester is designed to protect. For a portion of their length the uprights are made parallel and set within a few millimeters of one another, but their ends are widely divergent, the upper portions being supported by additional insulators a' b'. The uprights are identical in form and construction, and are made of copper wire or rods.

When the device is connected for the protection of a circuit, a discharge of lightning will arc across the narrow space separating the uprights and be conducted to ground. Should the arc persist, it will quickly travel upward between the diverging uprights e f until lengthened sufficiently to destroy it. This extinguishment of the arc is the result of thermal and electrodynamic actions. When the arc is established, as at e' f', the surrounding air is rapidly heated, causing an upward current of air at that point, which tends to carry the arc with it. In addition to this cause it is well known that conductors under the influence of an electric current tend to arrange themselves in parallel positions. The arc e' f' being practically at right angles with uprights, the portion e' tends to assume the position of the upright e and acts with the upward current of air in lifting the arc. Similarly the portion f' tends to assume the position of upright f. Thus any arc which may be formed between the uprights is quickly raised to their divergent portions and thereby becomes self-extinguishing, both the above-mentioned causes, the thermodynamic and the electrodynamic, coacting to drive the arc upward and extinguish it.

It is evident that the maximum effect is secured when the thermodynamic influence acts with the electrodynamic to drive the arc upward. This, however, can only be accomplished when the uprights are electrically connected with the circuit and ground, so that the arc is the uppermost part of the path of the current which is flowing. The connections should therefore be made at the lower ends of the uprights, for, if they are made above the arc, the electrodynamic force would act in opposition to the thermodynamic force.

This lightning-arrester has been found to be particularly efficient and certain in its action when connected for the protection of circuits of high voltage. Its parts are stationary. Hence there is absolutely no liability of the device to get out of



OELSCHLAGER AND SCHROTTKE'S LIGHTNING ARRESTER.

order. It is easily adapted for out-of-door service merely by protecting it with a hood, and, when once put into position, it requires no further attention.

PERSONAL.

H. M. LITTELL, THE NEW MANAGER FOR THE METROPOLITAN.

H. M. Littell was elected vice-president and a director of the Metropolitan Street Railway Company of New York City last week, after which President H. H. Vreeland appointed him general manager of the company. Mr. Littell has always been a railroad man. He began work in that line with the Louisville City Railway, in 1874, when he was eighteen years old. From 1883 to 1885 he was general manager of the St. Paul City Railway Company. His next service was with the Louisville and Nashville. He next became general freight and passenger agent of the Chicago, St. Paul and Kansas City Company, and in 1888 he was engaged with the Cincinnati Inclined Plane Railway. In 1893 he was appointed general manager of the New Orleans Traction Company, and in July, 1895, he became president and general manager of the Atlantic Avenue Railroad Company of Brooklyn, holding that place until the line was absorbed by the Nassau Electric Company.

WILLIAM SLOCUM BARSTOW.

In re-electing Mr. Barstow as its secretary, the Association of Edison Illuminating Companies marked its appreciation of faithful and intelligent service. Mr. Barstow was born in February, 1866, and educated at Adelphi Academy, Brooklyn. He then attended Columbia College, entering in 1883 and graduating in 1887. He had a marked taste for electricity and went into the employ of the Edison Machine Works in the summer of 1887, there continuing until May, 1889. He then resigned to become Assistant Superintendent of the Edison Electric Illuminating Company, which was beginning a career of active expansion and needed youthful energy and talent. In September, 1890, he was made General Superintendent of the same company. In July, 1895, he became in addition General Superintendent of the Citizens Electric Illuminating Company and director in it, and thus may be said to have both these large concerns, now united, under his technical and engineering direction. Mr. Barstow takes great interest in general electrical matters and is vice-president of the Electrical Department of the Brooklyn Institute. To his ability as a mechanical and electrical engineer the success of the Brooklyn stations and his frequent contributions to the technical press bear abundant witness.

W. S. BARSTOW.

MR. PATRICK B. DELANY has been awarded the Elliot Cresson gold medal by the Franklin Institute of Philadelphia for his ingenious system of machine telegraphy.

MR. H. GORDON STOTT, electrical engineer of the Buffalo General Electric Company, has been a visitor to New York recently, inspecting local central stations and enjoying the pleasures of the seashore at Bay Ridge.

Mr. MAX OSTERBERG, E. E., A. M., has opened an office at 27 Thames street as Consulting Engineer and Electrical Expert. He will continue to devote considerable time to the Röntgen rays, being busy at present making complete installations in several hospitals. He will make a specialty of gas engine plants for private residences and isolated plants.

POWER SUPPLIES WANTED FOR MARE ISLAND NAVY YARD.

The Navy Department, through the Bureau of Supplies and Accounts, is inviting proposals until September 8, for furnishing the Mare Island Navy Yard, with 175 kilowatt dynamos, one switchboard and instruments; two 5 horse-power stationary motors; three 2 horse-power, portable drills; four ¼ horse-power electric blowers; seven switch boxes; 125 insulators, special cable, L material; 125 locust pins; 3,800 feet B. & S. cable, copper wire; 5,000 feet cable copper wire; 400,000 circular mill sections; 150 lamps, 16 candle-power; 110 volt T. & H. sockets, porcelain fittings; 900 feet twin conductors, rubber insulated flexible cable.

Prospective bidders can obtain additional particulars by addressing Edwin Stewart, Paymaster General U. S. Navy, Washington, D. C.

READING, PA.—The prison inspectors have decided to equ'p the Berks County Jail with an isolated electric light plant.

Society and Club Notes.

EIGHTEENTH ANNUAL CLAM-BAKE OF THE AMERICAN ELECTRICAL WORKS, PROVIDENCE R. I.

CLAMBAKES for electricians at Providence now number eighteen, and the latest always seems the best.

When the invitations to the eighteenth annual clambake of the American Electrical Works, were received this year, they attracted more than usual interest, as it was seen at once that Mr. Phillips had once more selected another club at which to entertain his guests, and the picture on the card representing the clubhouse showed it to be a building of superior and commanding site and architectural attractions. Nor were the hopes of the visitors disappointed, as on arrival at the Pomham Club, it was at once seen that the house occupied a site of unusual beauty, on a bluff opposite Pomham Light, commanding an uninterrupted view of the whole Providence River. The house itself also possesses great attractions of its own, having been built for a permanent institution and with every provision for entertainment self-contained. The entire ground floor is occupied by the dining room, surrounded by a wide piazza equipped with numerous easy rocking chairs, in which we could enjoy the balmy breezes from Narragansett Bay and as beautiful a panorama as the eye could desire. On the second floor were to be found a large billiard room equipped with four tables, and a large music and card room, and a smaller room which was liberally patronized containing the famous Phillips' punch bowl. A short distance away from the main building is situated a very complete bowling alley, in which the visitors soon made some startling scores.

When the morning dawned, it looked anything but promising, and in the early hours it was raining heavily. Those who knew best, however, did not lose hope, as good weather has come to be considered a regulation feature at these annual entertainments, and there seems little doubt that Mr. Phillips has some secret understanding with the weather clerk, as it never fails. And so by the time breakfast had been served, the clouds began to ascend, ceased from their anxiety to water the earth for that day, and then proceeded to afford a very grateful shade from the fiery glances of the sun, which, however, could be seen smiling between the drifts, on the merry doings of some two or three hundred busy business men, let loose for one day to enjoy the entertainment provided for them.

Of the dinner itself, it is almost unnecessary to write. It was of the same excellency that has always characterized them, and was enjoyed by about 225 guests, who pronounced everything good from the opening course of clam chowder (and there is no better chowder to be procured anywhere in this wide world), down to the watermelon, ice cream (which, by the way, is a distinct but very welcome innovation at these dinners), coffee and cigars. Towards the close of the feast Mr. Phillips called upon Col. Ballou to act as chairman and toastmaster, which he did with great thoroughness and satisfaction.

The first toast proposed was the "Electrical Press," an honor rather unusual so early in the proceedings, which was gracefully responded to by Mr. R. F. Ross, who spoke feelingly of the esteem and love which was universally felt for the host of the day, and then alluded to the mutuality that should always exist between the electrical manufacturer and the electrical press. Mr. Phillips then read a number of names of departed friends, and a silent toast was drunk to their memory. The toast of telegraphy and telephony was replied to by Mr. Thomas D. Lockwood, who was in a particularly happy vein, and succeeded well in holding the attention of his auditors with an amusing talk on almost anything but the subject of the toast, which he claimed to be every after-dinner speaker's privilege. The speech of the day, however, was undoubtedly made by Col. J. C. Wyman, in response to the toast of "Love and Duty." Col. Wyman is an able orator, and he held the attention of the audience rivetted, with a graceful flow of language on the beauty of love, while he convulsed them with laughter, when he acknowledged that his own loves were so numerous that he could not keep any record of them. The day has gone by he said, for the one love of a life time; one has to love often to fully appreciate what it is. It was, however when he came to Duty that he aroused the audience. Duty, he said, was not nearly so pleasant a theme to deal with, but it had to be recognized, and after some stirring phrases, he wound up by an eloquent appeal for every man to do their duty at present in this great financial crisis that is upon us, by a careful study of the situation, and a determination to preserve the nation's credit at any cost.

Mr. H. B. Cram, in his usual happy way replied to the toast of the "Electric Light," and Capt. Brophy made a few happy remarks on the wonderful progress of the electric railways in response to the toast to that branch of the business. After a rousing vote of thanks to the American Electrical Works and to Mr. Phillips, the party broke up, well satisfied with their day's outing.

The usual photograph was taken just before the dinner. and a little memento of the occasion was distributed during the dinner in the menu card, on which was represented the clam digger at work, and to which was attached a silver model of the familiar hoe, with the words, "Don't be a clam," "Hoe your own row."

Mr. Phillips is to be congratulated upon the selection of the Pomham Club for his annual entertainment, as it would be difficult to concieve of a place more perfect in itself, and occupying a site so that even to do nothing but to "sit and look" becomes a pleasure.

ST. LOUIS MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION.

THE following papers have already been promised for the St. Louis convention:

"Track and and Track Joints, Construction, Maintenance and Bonding," by M. K. Bowen, superintendent, Chicago City Railway Company, Chicago.

"Trucks," by Jno. N. Akarman, superintendent, Worcester Consolidated Street Railway Company, Worcester, Mass.

"How can the Revenue of Street Railways be Increased, Taking into Consideration the Collection of Fares, Method of Registry, Transfers, Use of Tickets or Cash Fare and Attractions Along the Line of Road," by C. Densmore Wyman, general manager, Milwaukee Street Railway Company, Milwaukee, Wis.

"The Modern Power House," by Richard McCulloch, engineer, Citizens Street Railway Company, St. Louis, Mo.

"Modern Overhead Electric Construction," by B. Willard, superintendent, New Orleans City and Lake Railroad Company, New Orleans, La.

"Selection and Management of Employés," (to be read at Executive Session), by W. F. Kelly, general manager, Columbus Street Railway Company, Columbus, Ohio.

The following applications for space in the exhibit hall have been made: Shickle-Harrison & Howard Iron Company, Commercial Elec. Supply Company, Street Railway Review, National Lead Company, American Electric Heating Corporation, Consolidated Car Fender Company, Missouri Car & Foundry Company, Missouri Malleable Iron Company, General Electric Company, The Johnson Company, Mica Insulator Company, Heine Safety Boiler Company, St. Louis Register Company, Devlin Street Car Brake Company, Sterling Boiler Company, Hartford Woven Wire Mattress Company, Standard Air Brake Company, Leschen-Macomber-Whyte Company, Meaker Manufacturing Company, H. W. Johns Manufacturing Company, The Diamond Truck Company, Paige Iron Works, J. G. Brill Car Company, The Peckham Motor Truck & Wheel Company, E. T. Burrowes Company, Scarritt Furniture Company, The Sargent Company, Wm. Wharton, Jr., & Co., The Creaghead Engineering Company, Theodore Fletcher, Chas. G. Smith, Munson Electric Conduit Company, Partridge Carbon Company, The Graham Equipment Company, Safety Car Heating & Lighting Company, American Car Company, Consolidated Car Heating Company, Central Union Brass Company, Walker Company, The Trojan Button Fastener Company, Given Campbell, The Adams & Westlake Company, R. D. Nuttall Company, Schultz Belting Company, Western Electric Supply Company for the Ohio Brass Company, International Register Company, Gold Street Car Heating Company, Bundy Manufacturing Company and the Brussels Tapestry Company.

Applications from those wanting space should be made at once to Mr. G. W. Baumhoff, Lindell Railway Company, St. Louis, not later than October 1. The applications already received require about 30,000 square feet.

SOCIETE INTERNATIONALE DES ELECTRICIENS.

The above society, whose headquarters have hitherto been established at 44 Rue de Rennes, Paris, will hereafter be located at the Central Electrical Laboratory, 12 and 14, Rue de Stael, where all communications should be addressed.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Railways:

OVERHEAD AND UNDERGROUND ELECTRIC ROADS.—By Mr. Braun. After a short discussion of the advantages and disadvantages of the cable and steam roads for large cities, the author discusses and explains the following electrical roads: City and South London R'way, Waterloo and City R'way, Central London R'way, Budapest and Boston Underground roads, Overhead R'way in Liverpool, Metropolitan West Side Elevated R'way, Chicago.—"Elektrotechn. Zeitschr.," Aug. 6, '96.

WALKER COMPANY'S SERIES-PARALLEL CONTROLLER SYSTEM.—By William Baxter, Jr. The description is accompanied by a diagram of the Walker Controller connections.—"Elec. World.," Aug. 15, '96.

LIGHTING EXPRESS RAILWAY SERVICE.—A peculiarly built railway, the invention of F. B. Behr, said to make a possible speed of 150 miles an hour, is illustrated and described in Lond. "Elec. Rev.," Aug. 7, '96.

COST OF MOTOR MAINTENANCE.—Fifty-two railroad plants have been investigated and a table gives the following data: Number of report; number of cars operated daily; men employed on motors, tracks and electrical equipment; day men; night men; monthly pay roll; inspection and repairs of trucks and motors; cost per car, mile; repair and inspection labor (this item varies from $.0185 to $.0013); average monthly mileage—motor cars; cost repair labor per car per month; cars inspected; cars overhauled.—"Street Railway Rev.," Aug. 15, '96

FREIGHT HAULING BY ELECTRICITY.—By F. W. M'Clement. The Winston-Salem (N. C.) railway has made successful use of its charter for hauling freight.—Prices are given in "Street R'way Rev.," Aug. 15, '96.

ELECTRICAL DEVELOPMENTS IN JAPAN.—Various rules and regulations concerning insulation, pressure, franchise, etc.—Lond. "Engineering," July 31, '96.

Measurements:

STANDARDIZING INSTRUMENTS.—By K. Wilkens. Method for standardizing alternating and polyphase instrumentsof the Allg. Elektr. Ges.—"Elektrot. Zeitschr.,, Aug. 6. '96

MEASUREMENT OF INSULATION RESISTANCE.—By A. O. Benecke. Author gives a theoretical solution for the measurement of insulation and resistance of any continuous current distributing system during operation.—"Electricity.," Aug. 19, '96.

Telephony, Telegraphy, etc:

STOCKHOLM SYSTEM OF LONG DISTANCE TELEPHONY.—By Hemming Johansson. A detailed description of the entire system.—"Elektrot. Zeitschr.," Aug. 6, '96.

HESS-RAVEROT-WEST SYSTEM OF TELEPHONE EXCHANGES.—By J. H. West. Reproduced from "Elektrotechn. Zeitschr." A new system which makes a minimum number of central stations and trunk lines possible.—Lond. "Elec. Rev.," Aug. 7, '96.

Central Stations:

ELECTRICITY WORKS AT HANOVER.—Annual report.—"Elektrot. Zeitschr.," Aug. 6, '96.

Biographical:

A BIOGRAPHICAL HISTORY OF ELECTRICITY.—Portrait of Franklin with a description of some of his experiments.—"Am. Elec.," Aug., '96.

Storage Batteries:

ACCUMULATOR ACCESSORIES.—Various forms of automatic switches are explained in Lond. "Electricity," Aug. 7, '96.

Isolated Plant:

BATTLESHIP "INDIANA."—An illustrated description of some electrical features.—"Elec. World.," Aug. 15, '96.

Dynamos and Motors:

LOAD LOSSES IN DYNAMOS.—By Otto T. Bláthy. Further experiments with energy losses in electric machines due to the armature currents lead author to conclude that it appears to be work spent in reversing the magnetization, of the iron, and consists of Foucault currents and hysteresis.—Lond. "Elec.," Aug. 7, '96.

Electro-Physics:

DISPERSION.—By Oliver Heaviside. A mathematical paper in which the author points to some apparent obscurities and inconsistencies which he found in Helmholtz's theory.—Lond. "Elec.," Aug. 7, '96.

Roentgen Rays:

ROENTGEN RAYS.—By J. J. Thomson, F. R. S. Rede Lecture delivered June 10, '96. A general review of the subject.—"Electricity.," Aug. 19, '96, and subsequent issue.

ROENTGEN RAY APPARATUS OPERATED FROM ALTERNATING CURRENT CIRCUITS.—By E. J. Houston, Ph. D., and A. E. Kennelly, Sc. D. The primary of the induction coil is connected to the alternating current mains through a resistance, the secondary is in series with a condenser and the primary of a Tesla coil and in multiple with a spark gap.—"Am. Elec.," Aug., '96.

Lighting:

RECTIFIERS FOR ARC LIGHTING.—By John Hesketh. Paper read before the Nor. Soc. of Elec. Eng's. The various ecomomies obtained by the use of the rectifier are discussed.—Lond. "Elec.," Aug. 7, '96.

ELECTRIC LIGHTING IN BELFAST.—By Victor A. H. McCowan. Paper read before the Inst. of Mechan. Eng's. Complete description of plant in which gas engines are used, driving dynamos of low tension.—Lond. "Elec.," Aug. 7, '96. "Electricity," Aug. 12, '96.

NEW LAMPS FOR OLD.—A new lamp has just been put on the market which seems to possess various advantages over the old types. The top end of the glass globe is silver plated and is shaped in such a way as to form a reflector.—Lond. "Elec. Rev.," Aug. 7, '96.

FUSES AND MAGNETIC CIRCUIT BREAKERS.—By Wm. Baxter, Jr. Author claims that the only proper place for fuses is in branch circuit.—"Elec. Eng'r.," Aug. 12, '96.

Power Transmission:

ELECTRICITY IN THE UNITED STATES NAVY.—By Frank W. Roller. Author states the requirements and methods pursued in laying out a plant for the various ships.—"Am. Elec.," Aug., '96.

ELECTRICAL DEVELOPMENT IN EUROPE.—The following figures are taken from "L'Industrie Electrique:" There are 560 miles of electric roads in Europe, which is an increase of 125 miles in one year. The number of electric cars has increased from 1,236 to 1,747 in the same time. Germany has 250 miles of electric roads and 857 motor cars. France has 82 miles and 225 motor cars. Great Britain has 65 miles, with 168 cars, and Austria-Hungary has 45 miles, with 157 cars. Next come Switzerland, Italy, Spain and Belgium in the order given, while Russia has but one electric railroad, with six miles of track and 32 motor cars, and Portugal ends the list with 1⅞ miles. Of the 111 European lines 91 are overhead trolleys, of which there were 35 in Germany, 12 in Switzerland, 10 in France and 7 each in England and Italy, and 6 in Austria-Hungary, etc. Of electric railroads with underground current there were but three at the beginning of this year, one each in England, Germany and Hungary. Nine lines are provided with an insulated central track, through which the current is conducted, eight of these railroads being in Great Britain and one in France. The remaining eight lines are provided with accumulators. Of these four are in France and two in Austria, and one each in England and the Netherlands. "Railroad Gazette.," Aug. 14, '96.

TRANSMISSION OF POWER IN MINES.—By Rankin Kennedy. The first of a series of papers in which a comparative study is made of steam and compressed air versus electricity. —Lond. "Elec. Rev.," Aug. 7, '96.

ELECTRICITY AND WATER POWER.—By Mark A. Replogle. Part II of this series deals with power at the falls of the Willamette, Oregon City, and with the power in Ottawa, Ont.—"Elec. Rev.," Aug. 19, '96.

TRANSMISSION AT RHEINFELDEN.—By Erich Rathenau. Abstract of a paper read before the Verband Deutscher Elektrotechn. This plant has been described in detail in "Elektrotechn. Zeitschr.," July 2, '96. "Elec. Eng'r.," Aug. 12, '96.

Electro-Chemistry:

WOLFRAM (Tungstate) ORE.—By R. Helmhacker. A description of where it is found and how it is utilized. Of interest at present on account of the fluoroscope.—"Engineering and Min. Journ.," Aug. 15, '96.

A NEW ELECTROLYTIC GENERATOR FOR OXYGEN AND HYDROGEN.—By W. S. Franklin. Preliminary tests made are recorded from the "Journal of the Franklin Inst." in Lond. "Elec. Eng'r.," Aug. 7, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 18, 1896.

Alarms and Signals:—

SIGNALING APPARATUS. A. P. Smith, Springfield, Mass., 565,933. Filed March 10, 1896.

A system and apparatus by which it may be clearly indicated at certain predetermined points whether a certain section of track is open or not, and to indicate also the direction in which a car has entered upon such section.

WATER ALARM FOR TANKS OR BOILERS. G. V. Sheffield, New York, 566,235. Filed April 10, 1896.

An electric circuit and sounding devices whereby an engineer may be instantly notified when the water in a boiler or tank shall have reached the low water line.

AUTOMATIC SIGNAL LAMP FOR ELECTRIC RAILWAYS. D. O. Beckwith, St. Louis, Mo., 566,283. Filed April 29, 1895.

Signal lamp operated by contact device placed on trolley wire.

Secondary Batteries:—

ELECTRODE FOR ELECTRICAL APPARATUS. W. Schafer and A. Heinemann, Berlin, Germany, 566,231. Filed Oct. 8, 1894.

A process for producing an active material for electrodes for storage batteries, subjecting a lead glycerate to the action of an electric current in presence of an acid containing a permanganate of a metal of the alkalies.

Conductors, Conduits and Insulators;—

INSULATOR SUPPORT. C. P. Toward, Putnam, Conn., 565,944. Filed April 13, 1896.

Details of construction.

INSULATOR FOR ELECTRICAL PURPOSES. A. J. P. Whitaker and F. G. Treharne, Llanishen, England, 566,045. Filed Sept. 3, 1895.

Details of construction.

INSULATION PROTECTION. G. B. Damon, Lowell, Mass., 566,064. Filed July 8, 1896.

A shell to cover the length of wire to be protected.

Dynamos and Motors:—

CONSTRUCTION OF DYNAMO ELECTRIC MACHINES. S. H. Short, Cleveland, O., 565,930. Filed May 4, 1896.

A construction of dynamos wherein access to the field bobbins or to the armature for inspection and repair is facilitated.

ARMATURE WINDING. S. H. Short, Cleveland, O., 565,931. Filed May 4, 1896.

The combination with a core, provided with peripheral seats, of coils bent to form end and side portions, said side portions arranged to be received and said seats and said bends arranged at a fixed distance from the axis of said armature.

POWER GEARING FOR ELECTRIC OR OTHER MOTORS. E. A. Sperry, Cleveland, O., 565,936. Filed June 29, 1894.

The combination with two revolving shafts, of cross-arms attached to said shafts, links connected to said arms and to each other, and comprising a resilient portion, and ball-and-socket joints at the junction of the links.

ELECTRIC GENERATOR OR MOTOR. C. E. F. Ahlm, Cleveland, O., 566,120. Filed May 16, 1896.

A self-contained machine having an attachment by means of which it may be hung upon the wall or ceiling without inverting the machine.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. H. J. Fisher, London, England, 565,971. Filed Feb. 26, 1896.

Means for economizing the current required for automatically controlling and regulating the carbon-feeding mechanism, for using at will with either continuous or alternating currents.

EXTENSION ELECTRIC LAMP HOLDER. E. C. Kuenneth, G. Schreier and C. Kuenneth, Mt. Olive, Ill., 566,193. Filed Jan. 21, 1896.

An extension holder for holding an electric lamp in different positions.

ELECTRIC INCANDESCENT LAMP. F. M. F. Cazin, Hoboken, N. J., 566,285. Filed July 24, 1893.

The material intended to become incandescent is supported upon one side or face throughout its entire length by solid material having a high point of fusion.

COMBINED GUARD AND STAND FOR INCANDESCENT ELECTRIC LAMP. E. Gahlau, Detroit, Mich., 566,287. Filed Dec. 27, 1895.

Consists of a wire frame.

Miscellaneous:—

APPARATUS FOR PRODUCING OZONE AND LUMINOSITY BY ELECTRICITY. E. Andreoli, London, England, 565,952. Filed April 3, 1895.

For description see page 210.

APPARATUS FOR INDIRECT ELECTROLYSIS. E. Andreoli, London, England, 565,953. Filed April 9, 1895.

The solution to be treated by the indirect electrolysis is contained in or passed through a compartment situated between the anode and cathode compartments.

SYSTEM FOR ELECTROPLATING VESSELS. J. H. George, New York, 565,975. Filed Aug. 21, 1895.

The combination of one or more portable baths, a pump for providing a continuous supply of solution thereto, and an air exhauster for producing suction against said bath.

HAIR CURLING IRON. E. B. Jacobson, Boston, Mass., 565,991. Filed March 12, 1895.

Comprises an electric lamp and bracket, electric wires within the bracket, one of said wires being broken, a spring connection whereby said break is bridged, and a curling iron provided with electric wires which are connected with insulated plates.

LIGHTNING ARRESTER. E. G. P. Oelschlager, Charlottenburg and K. O. F. Schrottke, Berlin, Germany, 566,011. Filed April 17, 1896.

For description see page 210.

ELECTRICAL ADVERTISING DEVICE. J. J. McCormack, Brookline, Mass., 566,087. Filed Jan. 25, 1896.

Method of revolving incandescent lamps within a stationary box.

ELECTRIC DENTAL APPARATUS. H. F. Waite, New York, 566,103. Filed April 16, 1896.

A switch arm provided with a stem carrying a contact device having variable diameters, a spring controlling the normal position of the contact device with relation to the arm, and means permitting a partial rotation of the contact device.

Railway Appliances:—

ELECTRIC CAR LIGHTING. W. J. Morden, deceased, L. H. Morden, executrix, Chicago, Ill., 565,918. Filed Oct. 22, 1895.

A trailing traction motor connected to a vehicle, a dynamo mounted on the frame and having a revolving armature driven from the motor wheels, and means for conveying the current from the dynamo.

ELECTRIC BRAKE. E. A. Sperry, Cleveland, O., 565,937. Filed Feb. 16, 1895.

A circular magnet constructed in parts, means for securing the parts together, a coil, a groove narrower at its face for the coil in one of the parts of said magnet opening into the joint between the parts.

POWER TRANSMITTING GEARING FOR ELECTRIC RAILWAY TRUCKS. E. A. Sperry, Cleveland, O., 565,938. Filed April 13, 1896.

A flexible coupling consisting of two discs, arms on said discs interlocking with each other, and elastic cushions interposed in, but not filling, the space between said arms.

CONTROLLER FOR ELECTRIC RAILWAY CARS. E. A. Sperry, Cleveland, O., 565,939. Filed April 23, 1896.

The combination, with its operating handle, of connections for closing the motor in a local circuit, brake magnets in said circuit, an automatic circuit-breaker in series with the brake magnets, and a shunt circuit, including an automatic circuit-breaker.

UNDERGROUND TROLLEY SYSTEM. J. Hoffman, Schenectady, N. Y., 565,985. Filed Sept. 20, 1895.

The current carried by an underground feeding wire is automatically switched onto a section of the contact rail by means of electro-magnetic circuit-closing devices, which respond to the attracting force of magnets carried by the car.

CONTACT DEVICE FOR CONDUIT ELECTRIC RAILWAYS. M. Stobrawa, Dresden, Germany, 566,035. Filed April 10, 1896.

A contact lever hinged or pivoted to a car adapted to be swung into the conduit, said lever carrying upon the lower end a contact arm and shoe to form electric contact with the conductor.

TROLLEY WHEEL. M. C. Furstenau, Detroit, Mich., 566,161. Filed Feb. 24, 1896.

Means for attaching or detaching the wheel to or from the pole, for lubricating the bearings, and for taking up the wear.

TROLLEY POLE FOR ELECTRIC CARS. S. H. Short, Cleveland, O., 566,237. Filed Feb. 17, 1896.

For description see page —.

TROLLEY FOR ELECTRIC RAILWAY CARS. J. Van Hoogstrate, Chicago, Ill., 566,252. Filed March 31, 1896.

A trolley and pole for electric railway cars, which efficiently take up slack in the controlling rope, prevent sudden upward motions of the pole, permit it to stay on the trolley wire, and sound an alarm when the trolley "jumps" the wire.

Regulations:—

APPARATUS FOR CONTROLLING MOTORS. S. D. Field, Yonkers, N. Y., 566,070. Filed June 18, 1892.

The combination of an electric elevator electromotor and its switch of a fluid switch, and means for actuating the switch motor from the cage, an outlet for a regulated leakage from the switch motor and means for supplying fluid to the switch motor.

METHOD OF CHANGING FREQUENCY OF PERIODIC CURRENTS. L. Gutmann, Chicago, Ill., 566,076. Filed Oct. 22, 1894.

Method of winding.

Telephones:—

TELEPHONE REGISTERING DEVICE. J. Curran, San Francisco, Cal., 565,965. Filed July 1, 1895.

A device, by means of which the subscriber to the telephone or the user of the telephone is enabled to register in his own office each time the telephone is used or a switch is made by the central office.

TELEPHONE SYSTEM. G. F. Durant, W. W. Dean, St. Louis, Mo., and W. A. Childs, New York, 565,968. Filed April 10, 1896.

A telephone trunking system between central offices, whereby a subscriber at one central office may be connected with a subscriber belonging to another central office, and signals given to the operators at the two central offices of the condition of the trunking wires.

TELEPHONE. C. A. E. Ruebel, St. Louis, Mo., 566,022. Filed July 25, 1895.

In a microphone transmitter, a suitable diaphragm connected to one terminal of a primary circuit, and a series of circumferentially grooved rods of suitably conductive material with which said diaphragm makes variable contact, connected with the other terminal thereof.

LEGAL NOTES.

TO REVOKE THE NORTHWEST GENERAL ELECTRIC CHARTER.

An application for quo warranto proceedings was filed on August 11, at St. Paul, Minn., with the attorney general by Selden Bacon, of New York, asking that the charter of the Northwest General Electric Company, of St. Paul, be revoked on the grounds that the concern had withdrawn from the State and had not maintained an office here since 1893. The attorney general took the case under advisement.

DISPUTE OVER A TROLLEY BRIDGE CROSSING.

A temporary injunction has been granted restraining the Long Island Electric Railway from laying rails over the wooden bridge at the Washington Avenue crossing of the Long Island Railroad in Jamaica, L. I. The writ was obtained by the Board of Village Trustees. The Trustees claim that the company agreed to build an iron bridge, and they say that when that bridge is constructed the tracks can be laid, and not before. Previous to the granting of the temporary injunction a force of deputy sheriffs was at the bridge, and they prevented the laying of the tracks. Officers of the road say they will build a new bridge, and that they want to use the present bridge for only thirty days.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

INCANDESCENT LAMP ADJUSTER.

THE INCANDESCENT LAMP ADJUSTER COMPANY, of Abingdon, Ill., have recently put upon the market a very handy device for adjusting the height of incandescent lamps, which are suspended from flexible cords. This device is illustrated in the accompanying engraving and is so simple that a printed

INCANDESCENT LAMP ADJUSTER.

description is hardly necessary to explain the manner in which it is applied. With this adjuster it is apparent that the height of the lamp may be regulated through a long range, and all necessity of putting knots in the flexible cord is avoided. The device is easily attached, durable, ornamental, and will be found of great convenience wherever flexible cords are in use.

THE WESTERN TELEPHONE CONSTRUCTION CO., CHICAGO.

This company reports that in spite of the hard times, orders are pouring in to such an extent that although they are working their factory to its utmost capacity they cannot keep up with them. The 900 capacity switchboard for La Crosse, Wis., has just been shipped. This board embodies the latest and best inventions and designs of the experts connected with this company. Orders from Fort Wayne, Ind., and Richmond, Va., telephone companies for increased capacity have been received almost before their original orders were filled.

Among the most recent contracts secured by this company are Carmi, Ill., 100 drop switchboard and telephones; Olney, Ill., 100 drop switchboard and telephones; Globe Telephone Company, Winchester, Ky., 100 subscriber equipment complete; Sandersville and Tennille, Ga., one 50 subscriber and one 40 subscriber equipment complete; Dunning Institute, the Insane Asylum of Cook County, 30 subscriber installation complete; Washington, Ia., 200 equipment; Fort Kent Telephone Company, Fort Kent, Mo., 50 capacity switchboard and Normal, Ill., 50 drop switchboard and telephones.

DIXON'S GRAPHITOLEO.

Dixon's Graphitoleo is a preparation of a very finely pulverized and very choice graphite and a pure petrolatum warranted not to gum or become rancid.

The merits and wonderful lubricating power of Dixon's flake graphite are well known to almost every engineer and machinist throughout the world. It has been tested by professors at the leading mechanical institutes, and also by the mechanical experts of the great railroad companies throughout the country, and declared to be the finest and best natural lubricant known.

An article combining a perfect lubricant and rust preventive, put up in convenient form, is something desired by every bicyclist, hunter and yachtsman, as well as by every office and household.

To all such and many others Dixon's Graphitoleo will be not only welcome, but indispensable. It is manufactured only by the Jos. Dixon Crucible Co., Jersey City, N. J.

NEW YORK NOTES.

OSCAR F. EHRLE, 652 Hudson street, New York, is busy on experimental work, gear cutting, electrical instruments, the building of arc lamps, etc.

WALSH SONS & CO., Washington street, Newark, have a large and varied line of second-hand electrical supplies and machinery on hand. At present they offer as a special bargain a fine Westinghouse Voltmeter almost as good as a new one.

M. T. DAVIDSON, 133 Liberty street, New York, has about completed the entire pump and condenser outfit for the Baltimore and Catonsville Electric Street Railway; included in this work are four of the Davidson vertical twin air pumps. The Detroit Electric Street Railway Company have also been recently fitted up with several large steam pumps of Mr. Davidson's make.

THE AMERICAN STOKER COMPANY has recently furnished the following stoker equipments: Pennsylvania R. R. Company Shops, Columbus, O., second order; Davis & Egan Machine Tool Company, Cincinnati, O.; Toledo Brewing & Malting Company, Toledo, O.; Michigan Carbon Works, Detroit, Mich., second order; John C. Roth Packing Company, Cincinnati, O., and Cleveland City Water Works, Cleveland, O.

THE PRENTISS CLOCK COMPANY, 49 Dey street, New York, are supplying a system of clocks for the new silver work factory of Messrs. Tiffany & Company at Forrest Hill, N. J. Thirty-three clocks were recently installed by this firm in Public School No. 1, Elizabeth, N. J. The Prentiss clock can be found throughout the country in many of the largest electric factories, stations, power houses, public buildings, etc.

THE HAMMERSCHLAG FIRE.—Although the recent fire in their factory severely handicapped Messrs. Hammerschlag & Company, Liberty street, they are fast getting matters into shape and running order. The dynamo brushes manufactured by them can be found in the pressrooms of the Southbridge Printing Company, Southbridge, Mass.; the St. Louis "Chronicle," St. Louis, Mo.; the "Evening Press" and "Chicago Mail," Chicago, Ill.; in the Vanderbilt Building, New York City; the Mathieson Alkali Works, Saltville, Va., and many other large plants.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., manufacturers of presses and dies, are running their works full-handed and on full time. They are quite busy and have a large number of orders in at the present time. In addition to an order from the Chinese Government for mint machinery they are fitting up three or four large outfits for bicycle factories and two or three for electrical factories. They have just shipped two large presses to Budapest, for an electrical works, and are shipping other foreign orders to India, Germany, England, etc. Mr. Fred. F. Smith, the secretary of the company, sailed on the St. Paul last week for Southampton, and will look up trade in England, France and Germany during his visit abroad.

THE EMPIRE SELF-LIGHTING OIL LAMP COMPANY have recently opened fine showrooms at 766 Broadway for the sale of their lamps. The line is a large and varied one, from plain to the most artistically designed goods and prices to accommodate the modest as well as the most fastidious purchaser. As explained in one of our previous issues, this oil lamp is lighted by electricity generated from dry batteries concealed in base of the lamp. The company is now putting on the market also the Empire Self-Lighting Bicycle Lamp. This ingenious invention enables the bicycle rider to light his lamp without dismounting. By simply pushing a button on the tool bag, in which are concealed the dry batteries connected with the lamp, it is lit at once. The lamp burns kerosine oil, gives a brilliant light and does not jar or blow out. The outfit sells for $6.00 complete. The salesrooms of The Self-Lighting Oil Lamp Company are in charge of Mr. W. H. Seidel, vice-president, and Miss Russell.

PHILADELPHIA NOTES.

F. E. BAILEY & CO., of Philadelphia, have received the franchise and contract for the lighting of Birdsboro, Pa.

THE NANTICOKE, PA., LIGHT COMPANY, through F. E. Bailey & Co., of the Betz Building, Philadelphia, have placed an order for a 600 horse-power Armington & Sims engine.

MACAU & COMPANY have been formed under the laws of Pennsylvania, as manufacturers of insulating materials. The incorporators are: W. H. Macau, R. W. Lysle, J. B. Tompkins,

A. Greene, G. D. Macau, E. Rice and H. M. Suple, of Philadelphia. The capital stock is $50,000.

The company proposes to maintain its patent rights and suit has already been begun in the U. S. Circuit Court against an alleged infringer.

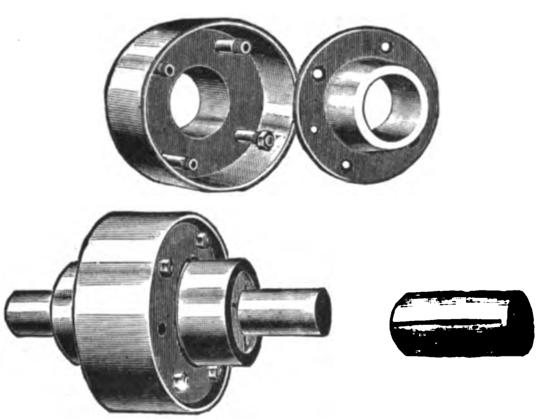
THE A. A. A. S. AT BUFFALO, N. Y.

During the current week, the American Association for the Advancement of Science will hold its annual meeting at Buffalo. The headquarters will be at the Hotel Iroquois. The president-elect is Professor E. D. Cope ,the naturalist. Several papers in electro-physics are promised.

The occasion has been seized for the holding also at Buffalo, during the past week, of the annual meeting of the American Chemical Society; and the week was also availed of for the annual meeting of the Society for the Promotion of Engineering Education.

THE SHAW COMPRESSION SHAFT COUPLING.

Messrs. Patterson, Gottfried & Hunter, Limited, 146 Center street, New York, are advertising the Shaw patent compression shaft coupling for which they are the agents. We herewith give a brief description of the accompanying cuts representing this ingenious invention. The sleeve, Fig. 1, is tapered from the middle down to each end; it has six slots running nearly its entire length, three from one end and three from the other end, in alternation, and holds the ends of the shafts by compression. The outer shell, Fig. 2, has a bore tapering from the middle outward, the taper corresponding with the taper on the sleeve, the diameter of the bore being slightly less than the diameter of the sleeve. It is divided in two, the halves being drawn together with four bolts and nuts, one-half having two pin holes in it. When the halves of the shells are drawn together by tightening the nuts on the bolts the pressure of the tapering bore on the tapering sleeve, which is compressible on account of the slots in it, causes the sleeve to grip the shaft. When in



FIGS. 1, 2 AND 3.—SHAW SHAFT COUPLING.

place, the flanges extend beyond the nuts and the heads of the bolts. When the coupling is to be taken down, after the nuts are taken off of bolts, the halves of the shell can be easily driven apart by drawing a pin through the pin holes. Fig. 3 represents a coupling fitted to a shaft. Among the many advantages gained are, that keys are done away with—key seating is done away with—shafts do not need to be centered, even if there be a slight variation in diameter; couplings do not need to be faced; a lack of alignment becomes evident at once; and a gripping power is obtained that will break the shaft before slippage takes place. There is an equally distributed bearing over the entire surface, covered by the coupling. Clothing and belting are not liable to be caught; shafts of different diameters may be united (with reduction coupling) without any cutting down.

These are among the most essential points in favor of the Shaw patent compression shaft coupling, which is certainly of such excellent merit as to commend the coupling to all having use for it.

Aside from handling the foregoing and many other specialties Messrs. Patterson, Gottfried & Hunter, Limited, carry a full line of machinery, metals, hardware, tools and supplies suitable for the electric as well as other trades. They are located at 146-150 Center street, New York.

NEW MODEL GRENET BATTERY.

Mr. M. R. Rodrigues, 19 Whipple street, Brooklyn, has brought out a new model Grenet battery, which he proposes to retail at the low price of 50 cents. The jar is 2½ inches square by 4½ inches deep. The cover is made in such a way that it serves to hold the carbon plates at the same time, the zinc being suspended at the center. For small motors and light experimental work, where large cells are out of the question, these new cells are useful. One of them will run the Rodrigues "Baby Motor," or the "No. 1 Premier Motor" two or three hours on one charge.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY have made special arrangements for the manufacture of cross-arms for telephone work; i. e., an arm 2¾ by 3¾, with holes for 1¼ inch pins. On these goods the Appliance Company are prepared to make specially low prices, and prompt shipments.

W. H. McKINLOCK, president of the Metropolitan Electric Company, Chicago, reports a decided improvement in business, especially in the telephone line. The Gordon cell, for which they are Western agents, is rapidly coming into favor with telephone, telegraph and railroad companies. The No. 1 Gordon cell is specially adapted for track circuit work, and the No. 2 for telephone work.

THE ELECTRICAL MAINTENANCE COMPANY of New York have opened a Western office at 1200-1202 Fisher Building, Chicago, where their interests will be taken care of by Mr. W. R. Mason, of the Mason Electric Equipment Company, and Mr. Wm. Sharpe. This young and enterprising company, although established only about two years, has met with great success in its unique style of business, which consists chiefly in keeping up and maintaining electric lighting plants in good working order at a small yearly cost to their owners. This company has amongst its regular customers several concerns and buildings in which there are large isolated plants, and the favor which this method has met with has prompted the company to extend their operations to the West, where there is a large field for this new line of business. Messrs. Mason and Sharpe, who have a thorough knowledge of the electrical trade, are quite sanguine that they will very shortly be able to add considerably to the number of customers which the company have already secured in the East and, although they have not yet got fairly started, they feel greatly encouraged with the favorable reception that has been accorded to the new undertaking by those whom they have seen on the subject.

NEW ENGLAND NOTES.

LEO T. LEVY has been appointed the agent for the Massachusetts Fan Company, manufacturers of the well-known Davidson and Starbuck exhaust fans. His address for the present is 169 West Fifty-seventh street, New York City. He is prepared to fill all orders relating to his specialties.

DODGE WOOD-WORKING POWER TESTS.—We are informed that the tests made by Prof. Dodge on power required by wood-working machinery, recently published in our columns, were collected by the "American Machinist" at heavy expense. We were in no wise aware of this fact, but hasten to give our esteemed contemporary credit and to felicitate it upon its judicious enterprise in setting such an investigation on foot.

ARMINGTON & SIMS ENGINE COMPANY.—The sudden death of Mr. Henry C. Cranston, the assistant treasurer of this company, who had charge of the financial management of the business, placed the company's affairs not long since in a very unsettled condition. Mr. G. C. Sims was elected treasurer about June 1, and since that time he has been working incessantly to get matters straightened out, and to get the business on a solid basis again. At a meeting of the creditors on Aug. 19, a proposition was made which will doubtless allow this concern to go on as before, a result that gives unbounded pleasure in every quarter. It is due to the untiring efforts of Mr. Sims that this decision has been reached, and it is satisfactory to learn that after a period of terrible strain, he has been able to break away for a few days' rest. The company has built up a world-wide reputation, and has doubtless before it a period of success and prosperity equal to any it has known in the past. Its services in the early days of electric lighting will not readily be forgotten.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

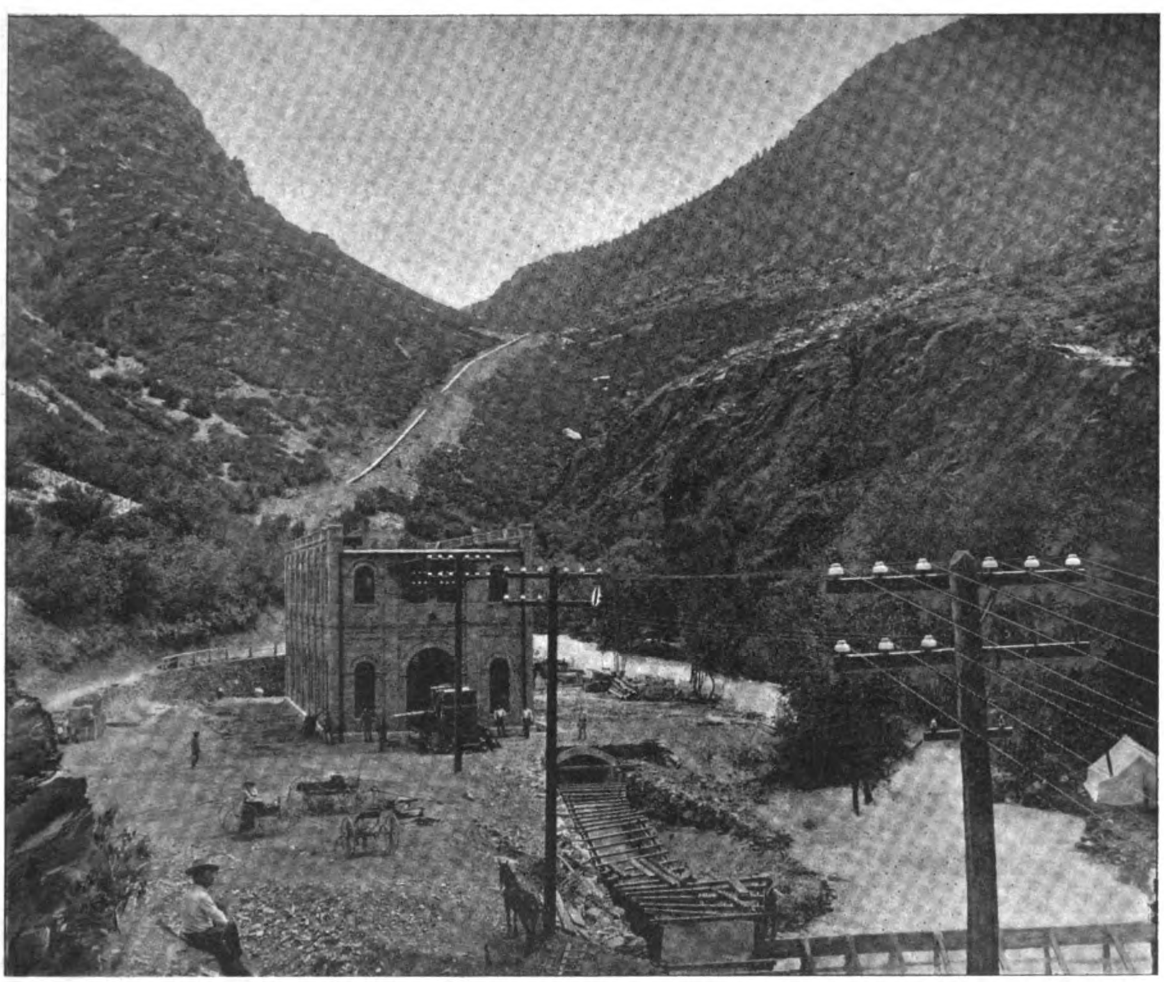
Vol. XXII. SEPTEMBER 2, 1896. No. 435.

Power Transmission.

THE BIG COTTONWOOD POWER TRANSMISSION, UTAH.

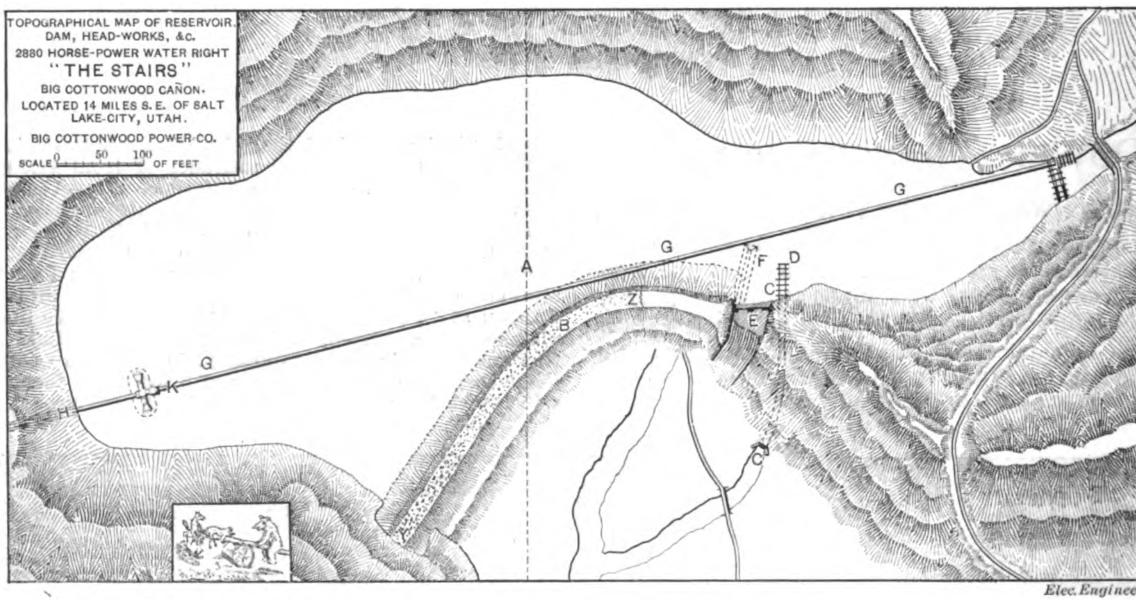
NEARLY a year ago, some interesting details were given in The Electrical Engineer (Sept. 11, 1895), of the work about to be done by the Big Cottonwood Power Company in utilizing electrically the water power of eight of the lakes in the Wahsatch Mountains and distributing it throughout the valley around Salt Lake City. We are now glad to report that the plans as first proposed by Mr. R. M. Jones and his associates have been carried out and that the plant is to-day in successful operation. A few notes and illustrations of this plant will, therefore, be in order. Events have moved quickly since we first brought the scheme to notice, and last Fourth of July witnessed the entrance of the State of Utah into the Union, when Salt Lake City, with its population of between fifty and sixty thousand celebrated the event with appropriate rejoicing. One feature was the hanging of a huge American flag as a canopy in the big tabernacle, its size being 125 feet by 75, and the forty-fifth star in it, typical of Utah, was a dazzling incandescent lamp.

It should be premised that the lakes emptying into the Big Cottonwood Canyon, lie at altitudes of from 11,000 to 13,000 feet above the sea, so that the difference of level is considerable even when the water is made to give up its energy at a point some thirteen miles southeast of Salt Lake City. As a matter of fact, the company has available over 1,000 feet of fall, in various spots, but at present is using less than 400. The power station to which we now direct attention is situated in the Canyon at "The Stairs," about 14 miles by pole line from the distributing or "step-down" station of the Salt Lake and Ogden Gas and Electric Light Company, in Salt Lake City. At this point there is a minimum flow of 3,400 cubic feet per minute, which, working under 380 feet head, produces 2,447 horse-power any and every hour in the year. During nine months of each year, it will give nearly 4,000 horse-power. The storage reservoir at the head of "The Stairs," has an available capacity of 24 hours' continuous flow of the stream, making all of the water available by using an excess during maximum loads and allowing the reservoir to accumulate during minimum loads. 58,800 horse-power hours per day of 24 hours, is looked for from this source, of which 68 per cent. can be delivered in Salt Lake City in contract form, making 40,000 horse-power hours net daily. The 68 per cent. efficiency is derived from: Pelton water wheels 80 per cent., General Electric Company gener-



Power House and Pipe Line, Big Cottonwood Transmission.

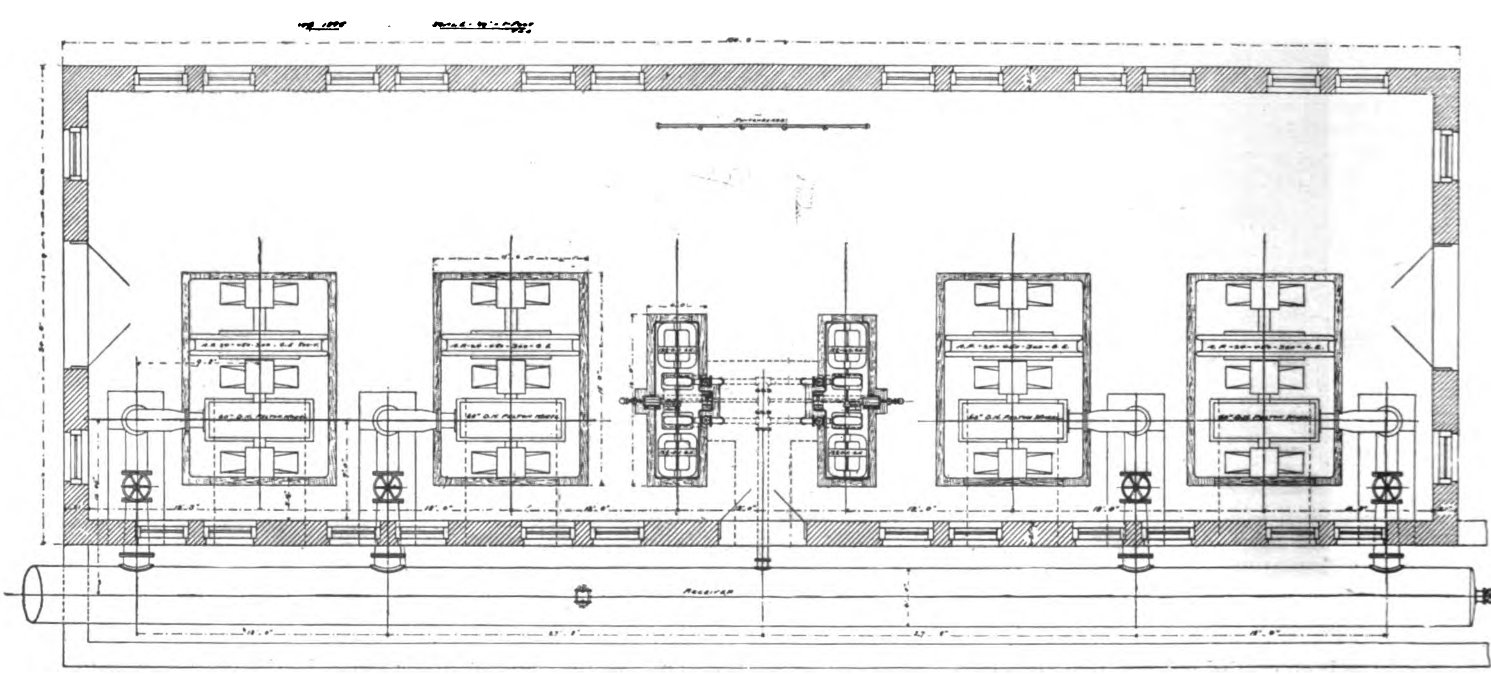
ators, 94 per cent., G. E. transformers (raising) 97½ per cent., line transmission 95 per cent., G. E. transformers (reducing) 97⅞ per cent., or a total of 68½ per cent. The map of the reservoir shows a pipe line extending from the head gates, submerged in the bottom of the reservoir, to a penstock or receiver wood housing with "grizzlies" located just below the bridge. tion and economical use of water are secured. Each nozzle at 370 feet effective head, produces 310 mechanical horse-power, and drives the wheel at 300 revolutions per minute, its economical speed. The water wheel is keyed directly on the armature shaft, in lieu of a pulley. In addition to the generators named, four 12½ kilowatt exciters are connected together



TOPOGRAPHICAL MAP OF BIG COTTONWOOD RESERVOIR: B Z, DAM; E, OVERFLOW GATE; G G G, SUBMERGED PIPE LINE; K, "GRIZZLIES."

This pipe, of steel-banded redwood, is anchored to the bottom by rock piles, and is to be used in the event of its being necessary to drain the reservoir, without interfering with the running of the station. This is accomplished by closing the head-gate valves, and the station can thus be supplied from the natural flow of the stream, during such time as the reservoir might be empty.

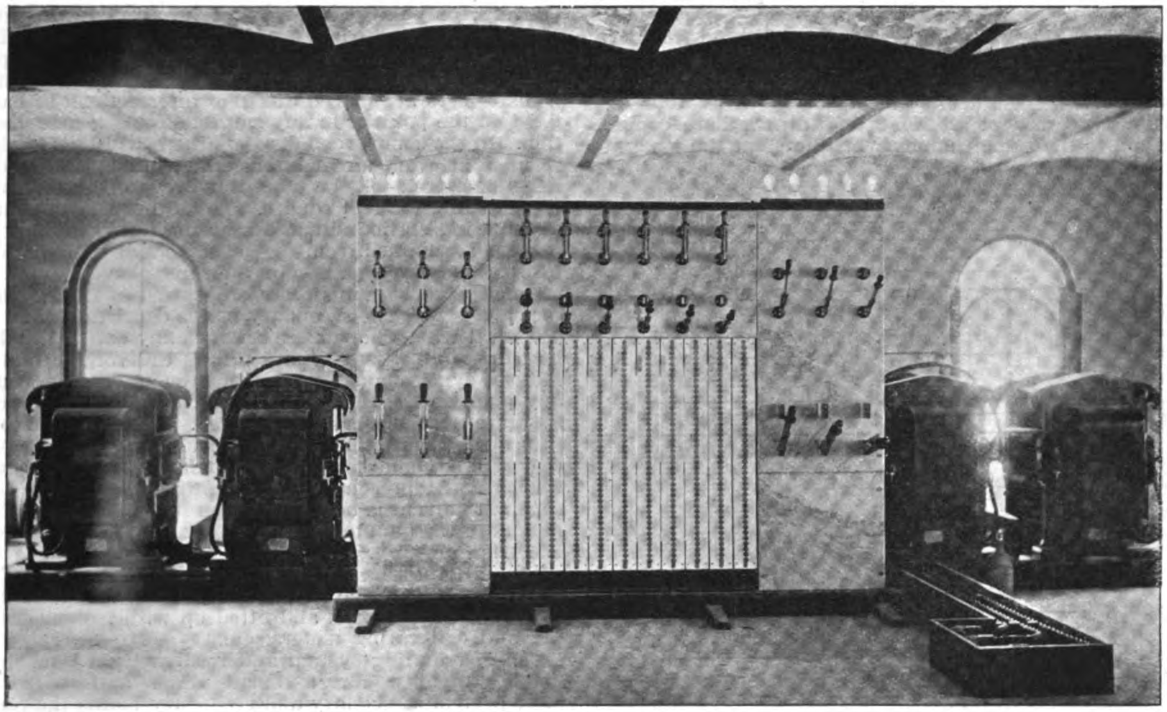
The outside dimensions of the generating station are 34 feet in pairs by couplings, each set being driven by a 14-inch Pelton wheel, with cast housings. Each set consists of two generators and two wheels, built up on a cast-iron base-plate, making a rigid and direct connection. This application provides exciting energy in two units, and at all times either one or two exciters are in reserve. The exciters are to be run in multiple, and all connected to one common "bus line" on the switchboard. The three-phase generators are also operated in



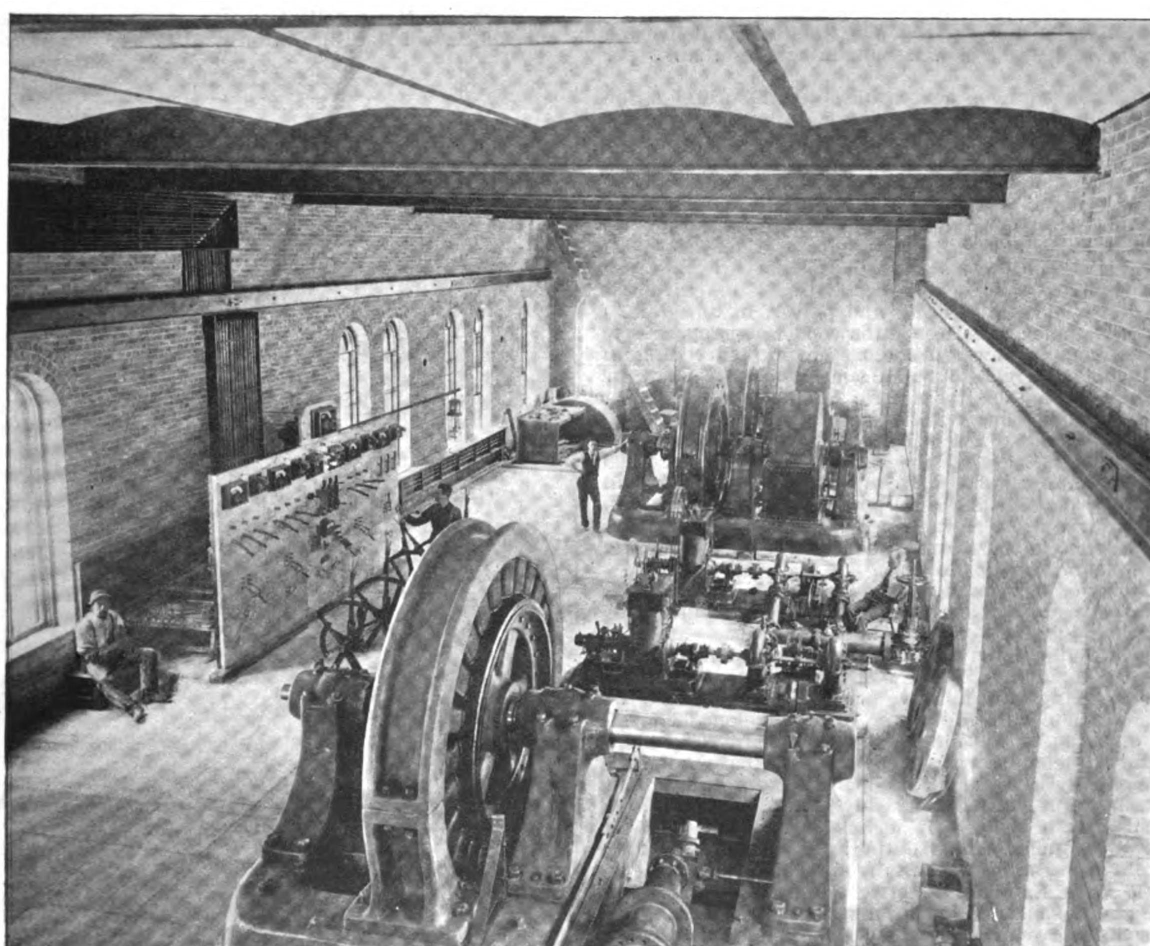
PLAN OF BIG COTTONWOOD POWER HOUSE.

by 100 feet. The generating plant consists of four 450 kilowatt three-phase 60-cycle General Electric generators, separately excited, non-compounded, set with armatures parallel to each other, facing up in true line in the building as shown in plan and in elevation on page 220. Each generator is driven directly by one heavy special Pelton wheel, 60 inches in diameter, provided with two nozzles of 3¼ in. diameter. The nozzles are provided with hood valves for shutting off, so that both good regula- parallel. There are six raising transformers, 265 kilowatts each, of General Electric make.

The station switchboard consists of 5 panels with complete controlling and indicating apparatus, and there is a 3-panel raising transformer switchboard. At the step down or distributing station, there is a 3-panel reducing switchboard, with proper regulating apparatus. The apparatus is protected by ball lighting arresters, and the transformers are cooled by two



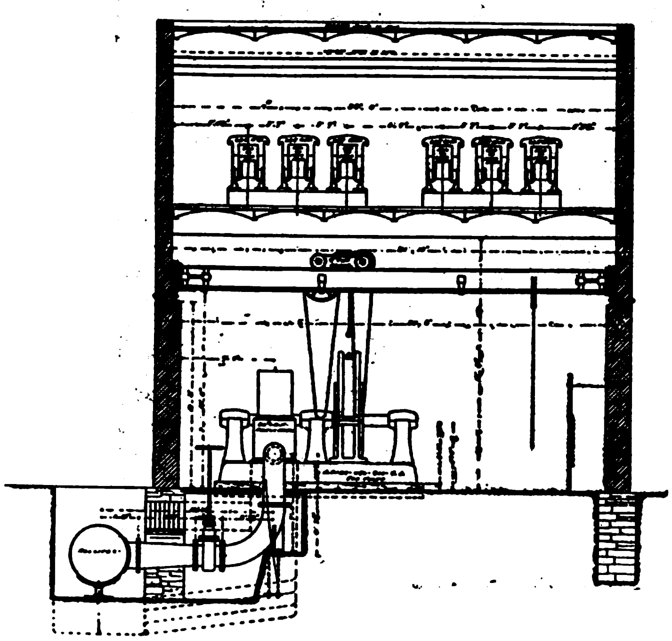
TRANSFORMER ROOM, BIG COTTONWOOD TRANSMISSION, SALT LAKE, UTAH.



GENERATING ROOM, BIG COTTONWOOD POWER TRANSMISSION PLANT.

Sturtevant exhaust fans driven by two 5 horse-power induction motors.

The 915 poles for the line construction were selected from live growth of Sand Point (Idaho) cedar. The smallest are 40 feet long, and 8 inches in diameter at the top. They are placed 100 feet apart. The line conductors consist of 12 wires, four circuits of three wires each; all No. 2, soft-drawn bare copper, and connected to the same common "bus line," at the generating and at the distributing station. The line loss, in delivering 1,520 kilowatts at 10,000 volts, is something less than 5 per cent.



Transverse Section of Big Cottonwood Power House.

The transmission line from generating to distributing station is 14 miles by pole line. The distributing station is owned by the Salt Lake and Ogden Gas and Electric Light Co., who rent it to the Big Cottonwood Power Company at a nominal rent. It contains, for "step-down" transformation, nine 160 kilowatt air blast transformers, from the secondary side of which the Electric Light Company buys the current wholesale by meter. This arrangement is a most convenient one for both companies. The actual terms of the contract are that the electric light company is to be supplied with all the current it can dispose of for electric lighting and power, in units of 10 horse-power, and under, the Big Cottonwood Company reserving the right to supply power to motors in units exceeding 10 horse-power, and the right to reach such wholesale users of power by wires erected on the electric light company's poles, throughout all the districts within the city limits. The contract dates from January 1, 1896, and runs for a term of five years. Its conditions are that the current is bought at 2,000 volts, three-phase, at a stipulated price per k.w. hour, which will be used to supply electric light and power for any purpose up to 10 horse-power, and for elevator service up to any limit desired by the lessees. 2,000,000 units annually is the minimum limit of the consumption of current.

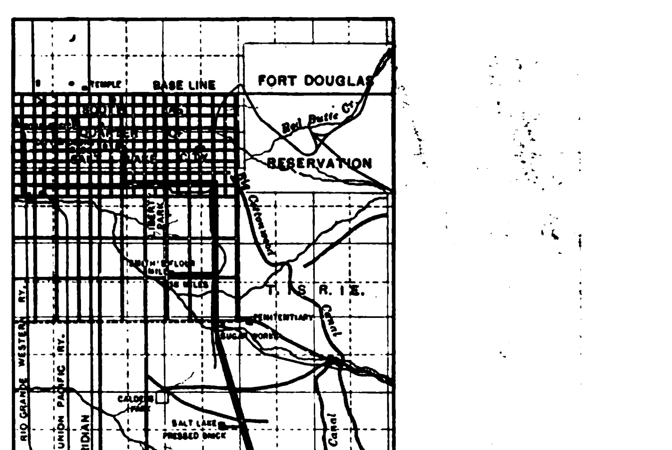
The final cost of the complete development is estimated at $300,000. An estimate of $300,000 for the original outlay for "The Stairs" would give for construction expenses—at 2,258 horse-power—$132.72 per net horse-power delivered in the city ready for use. The future of the company seems to be well assured. The company's affairs have been so well administered that much more than half the power to be developed has already been disposed of absolutely, and the guaranteed total revenue from completed contracts is over $100,000 annually. Although the company is confining its operations for the present to "The Stairs" supply, it has, as already stated, other valuable water rights partly developed by means of which it could at any time largely supplement its output.

In order to secure the best results from the three-phase current the Salt Lake Gas and Electric Company, originally a single-phase plant, has modified its distribution system. The new system consists of a network of primary mains with a network of low tension secondaries, wherever the houses are in close proximity to each other. The primary mains are at 2,000 volts. They run along every street east and west and have equalizing cross mains on several streets running north and south. There will eventually be ten feeding points, though at first only six are required. Secondary mains are used almost entirely; only when the houses are very scattered separate house transformers are used. In the commercial district, the secondary and primary mains will eventually be put underground, though this is not immediately contemplated. The transformers are placed at street intersections in banks either fixed on the poles or in any suitable location near the intersection. In the commercial districts there will be a bank of transformers at every street intersection; but in the incidental districts one bank will be placed at every other intersection, the blocks being 792 feet square. The feeders are brought from the distributing station situated near the center of the town. The current is supplied from the generators of the Big Cottonwood Power Company's station on the three-phase system. The feeders and primary mains therefore consist of three wires each of the same size. The secondary mains consist of three wires and a neutral wire. The voltage between any one of the three wires and the neutral is 115, and this is the voltage of the lamps. Motors, synchronous or non-synchronous, can be connected at any point to the secondary mains, or, when the motor is large, separate transformers will be used. It is intended to eventually use the alternating current for all arc lamps, in which case they will be connected to the secondary mains with small transformers. At present the arc lighting of the city is done by constant current generators driven by three-phase synchronous motors in the old steam power house of the Salt Lake Gas and Electric Company.

The distributing station is a substantial fireproof building, with a room for the 10,000 volt step-down transformers, the 2,000 volt switchboard and fitted up with instruments for testing and calibrating meters, etc.

The distributing system and feeders have been designed of ample capacity for a small drop, and with the complete system of primary and secondary mains the regulation is perfect. By cutting out transformers during times of light load, it is expected to obtain a very high distribution efficiency. The Stairs plant of the company was completed in time to deliver current in Salt Lake City by June 1. A few days after, the greatest flood seen in thirty-five years rushed through the canyon, thus testing in the severest manner the strength of the construction. Not a dollar's worth of damage was done.

The officers of the Big Cottonwood Power Company are John

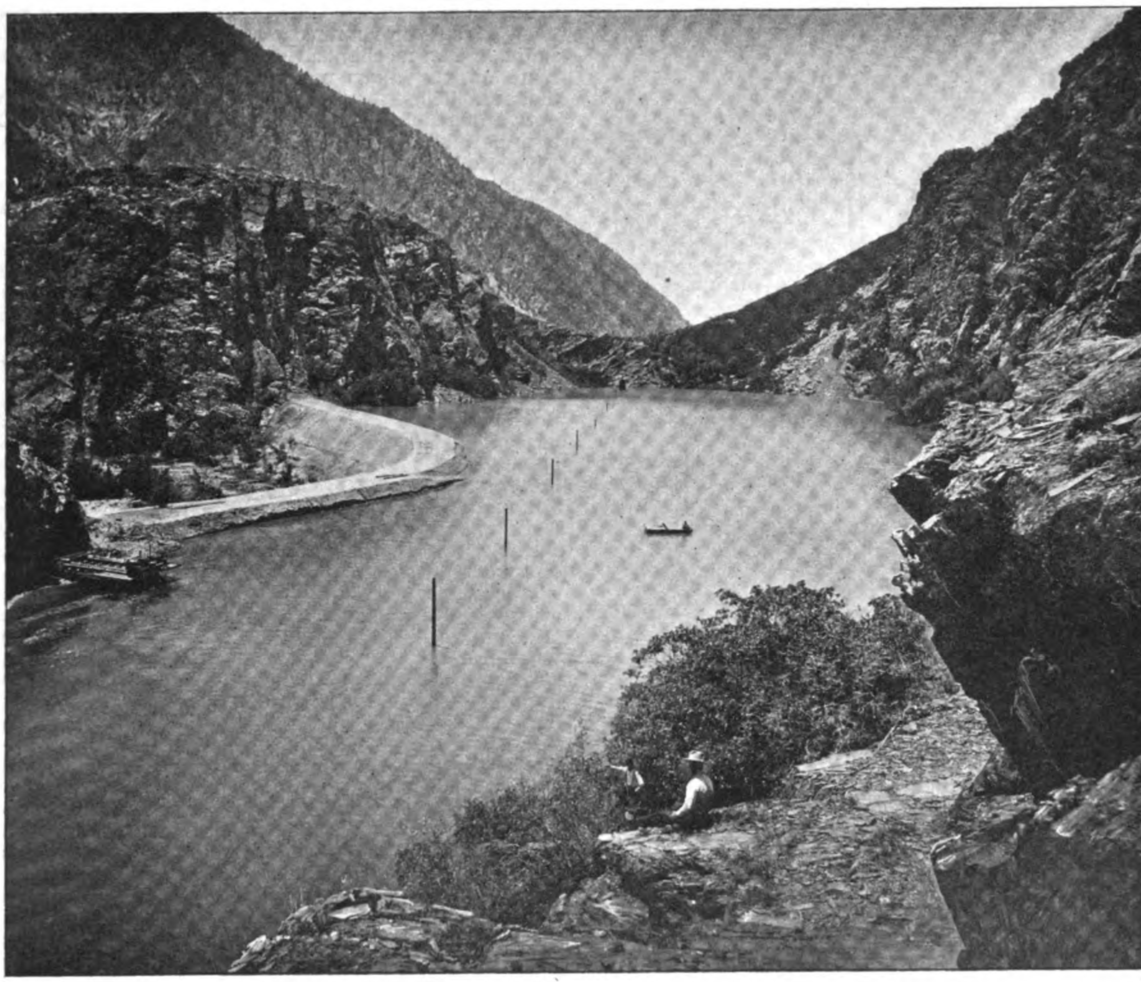


Map Showing Big Cottonwood Power Line.

W. Donnellan, president (cashier Commercial National Bank, Salt Lake); W. H. Rowe, vice-president (president Bear River

Canal Company); Geo. M. Cannon, secretary (cashier, Zion's Savings Bank, Salt Lake); G. M. Downey, treasurer (president Commercial National Bank, Salt Lake); R. M. Jones, engineer and manager, Salt Lake; Jos. W. Summerhays, director, Salt Lake. The Old Colony Trust Company, of Boston, is its trustee.

At the present time, The Stairs plant, at ruling rates for current, can earn $200,000 per annum, and it would seem that a ready market exists for light and power now, some 27 concerns using over 2,000 horse-power. Many of these establishments work every day the entire year, and their steam power has cost them from $90 to $145 per horse-power per year.



DAM AND RESERVOIR, BIG COTTONWOOD ELECTRIC POWER TRANSMISSION.

TONAWANDA FRANCHISE FOR THE NIAGARA FALLS POWER CO.

The Tonawanda Common Council has granted a franchise to the Niagara Falls Power Company. It gives them permission to construct, maintain, and operate conductors for the Niagara Falls electric power, subject to the inspection and approval of the trustees or the engineers appointed by them. The franchise contains the usual stipulations for the welfare of the village. The company agrees upon the application for 500 electrical horse-power to distribute it within the village limits at a price not to exceed that paid by North Tonawanda or Buffalo and further agrees to have power transmitted within a year from date or forfeit the franchise. The route of the transmission line is in general a strip thirty feet wide.

ELECTRICITY FOR STOCKTON, CAL. AND THE MOTHER LODE.

The California Exploration Company, of which Prince Poniatowski is president and Will H. Crocker treasurer, has completed a contract with the Blue Lakes Water Company, by which the former secures from the latter 5,000 horse-power, to be increased as may be required. The immediate field to be exploited is Stockton and the mines on the mother lode. The company expects to furnish power to operate every street car line, flour mill and factory in San Joaquin district. The Exploring Company, itself, is going into mining. It has bonded three miles of ground on the mother lode, extending in a southeasterly direction from the Mokelumne River, through Calaveras County. Sinking operations are to be commenced at once. The plant is to be completed for at least 1,500 horse-power within nine months. Percy Tarbutt and Edmund Davis of London, are largely interested in the scheme. Jesse W. Lilienthal is counsel for the Blue Lakes Company and W. S. Goodfellow and Morrison & Foerster for the Exploration Company. Richard A. Parker of Boston and John Hays Hammond will have charge of the operations.

ELECTRICITY AT VANDERGRIFT, PA.

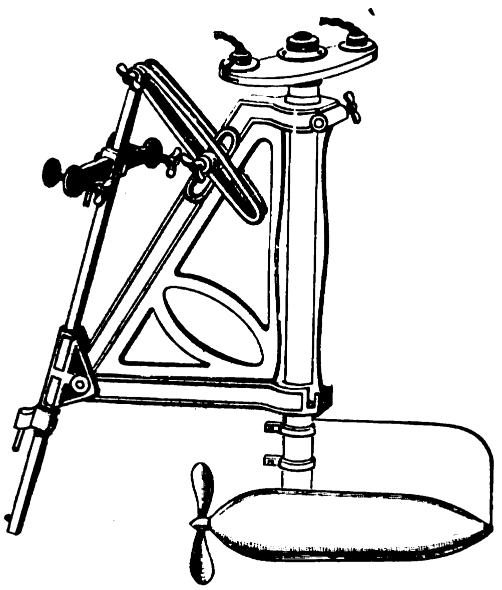
Electricity performs a very large part in the new steel plant of the Apollo Iron and Steel Works, at Vandergrift, Pa. The electrical power plant consists of three 400 horse-power side crank medium speed engines of the latest type recently brought out by the Ball Engine Company, Erie Pa., which are direct connected to Westinghouse generators. These generators deliver current to 36 different power motors operating various machinery, including the electrical centrifugal pumps furnishing the water supply of the steel works, which comes from the river, 1,200 feet away.

MR. JOHN FINLAY, of Holywood, Ireland, an English electrical engineer, is inspcting the mining camps of Colorado, and is said to be collecting data as to the use of electrical power in getting out low grade or deep ore by means of electrical power. The work done in America in the department of electric mining is attracting the attention of mining engineers throughout the world.

Electric Transportation.

THE NEW & MAYNE ELECTRIC BOAT.

A REPORT from Brighton, England, states that the New & Mayne electric motor rudder boat has made a trial trip to sea with very good results. The boat is 30 feet in length, with a

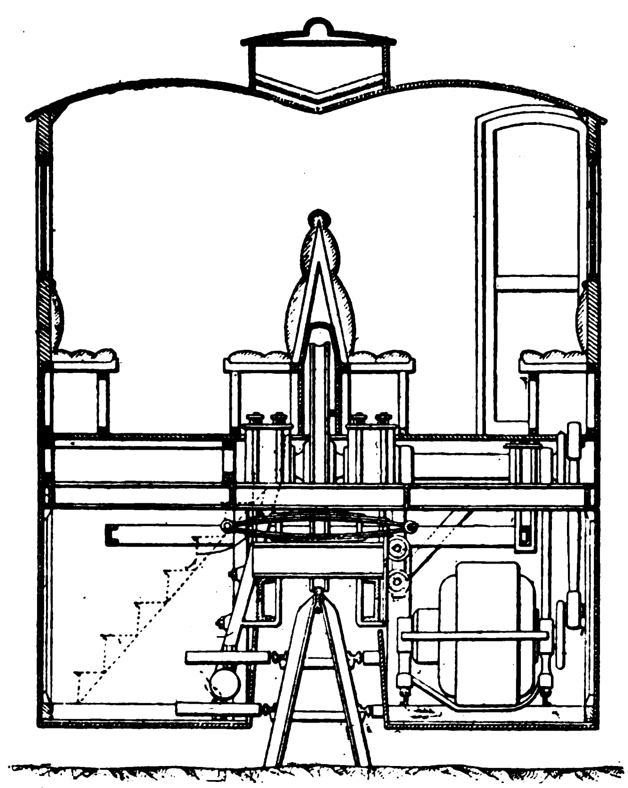


New-Mayne Rudder Motor.

beam of 6 feet, and is fitted with the electric motor close to the keel. The motor is driven by accumulator cells, which fit neatly into the waist of the boat.

BEHR'S HIGH-SPEED RAILWAY.

CONSIDERABLE attention is being given by the English technical press to a system of lightning express trains invented by Mr. F. B. Behr. The method proposed provides for



The Behr Single Rail High Speed Road.

a speed of from 100 to 150 miles per hour, and it has also been before the public for several years, but without meeting with any practical application heretofore. It is now about to be put on trial at Brussels, where a line about three and one-eighths miles long and oval in form will comprise one of the attractions of the 1897 exhibition to be held in that city.

A cross section of the car and general arrangement of the track is shown in the illustration. It will be seen that four guide rails are necessary, and the top rail which bears the weight of the train is supported at from 40 to 60 inches above the ground. Each carriage is supplied with its own motive power, so that little strain is put upon the couplings.

On the Brussels line the guarantee of 95 miles per hour has been given for running over the curves of only 550 yards radius. The mechanical stress when running at 95 miles per hour on the above-mentioned curves reaches an alarming amount. Thus, the centrifugal force tending to throw the cars outwards reaches the respectable figure of 20 tons. This stress is to be taken by the guide wheels on the inside.

The following are the improvements claimed by Mr. Behr, the mention of which may be of interest to our readers.

Firstly, the carriages have a considerable total length to enable them to pass readily round sharp curves. This is effected by constructing the carriage in two or more separate parts, joined together by a pivot or universal joint. A flexible enclosure covers a platform between the two adjoining parts, from which access is gained to each part. Each half is supported on the rail by two driving wheels, placed as close as practicable together so as to obtain a comparatively small fixed wheel base.

Secondly, the center of gravity of the carriage is kept below the level of the line of rail, even when the entire floor for the passengers is raised above the line of rail. This is effected by placing the motors that propel the carriage at the bottoms of the two lower parts of the vehicle, and so arranging them that although they partake of the vertical motion of the carriage body upon its springs, the distance between their driving shafts and the driving wheel axles, by which they are connected by driving gear, shall always remain constant.

Thirdly, the carriage body, though having a vertical motion on springs, is so guided that it cannot move laterally; this is effected by constructing the framing carrying the driving wheels and bogie entirely separate from the framing of the carriage body and guiding the former in a vertical position by means of guide wheels running on lateral guide rails on the line rail supports. The framing of the carriage body, which rests upon the wheel framing with springs, is prevented from lateral motion by providing the wheel frame with vertical rails, against which bear rollers attached to the carriage body.

Fourthly, two guide rails are provided, situated one above the other, against which bear two corresponding guide wheels on each side of the wheel frame of the carriage. In order to ensure that both wheels shall always be kept automatically in contact with both the guide rails so as to distribute the lateral strains on the carriage uniformly over both, the guide wheels are mounted upon vertical arms projecting upward and downward from a horizontal axis that can turn in bearing in brackets on the wheel frame.

TROLLEY CAR COASTING ON CATOCTIN.

A car with a capacity of 48 passengers, but carrying 110, had some lively experiences on the Catoctin Mountain section of the Fredericksburg and Braddock Heights trolley road on August 23. Soon after leaving the mountain crest, the motorman lost control of his car, the brakes would not work, and the car went coasting. It managed to cross a trestle 400 feet long and 45 feet high, but soon struck a curve and ran about 100 yards on the crossties. It then fell over an embankment seven feet high and landed on its side. Marvelous to tell, nobody was killed, but nearly forty people were injured.

NEW ENGLAND RAILWAY CO. SEEKS TO RESTRAIN TROLLEY COMPETITION.

Counsel for the New England Railway Company have filed in the Superior Court at Hartford, Conn., an amended complaint against the Central Railway and Electric Company, of New Britain, the Newington Tramway Company, and the Hartford Street Railway Company, in its suit to restrain those companies from building a trolley road between this city and New Britain. The original writ was filed in June. In the new complaint the New England Road alleges that on March 21, 1896, the Hartford Street Railway Company and the Central Railway and Electric Company, of New Britain, entered into a conspiracy to defraud the New England Road of its just rights by building a trolley road to carry freight and passengers between New Britain and this city. The complaint further alleges that in furtherance of this conspiracy 121 shares of the Newington Tramway Company were illegally transferred to four directors of the Hartford Street Railway Company. All this is denied in the reply.

TWO HUNDRED HORSE-POWER BALDWIN-WESTINGHOUSE ELECTRIC MINE LOCOMOTIVE.

THE Baldwin Locomotive Works have recently delivered to the Crozer Coal and Coke Co., at Elkhorn, W. Va., the largest electric mine locomotive ever built. The common electric mine locomotive has about 50 horse-power capacity and seldom exceeds 80. In this case the work was so heavy that a special steam locomotive was designed to be substituted for an inadequate electric locomotive formerly used in the mine. The Baldwin company offer the same guarantees for both steam

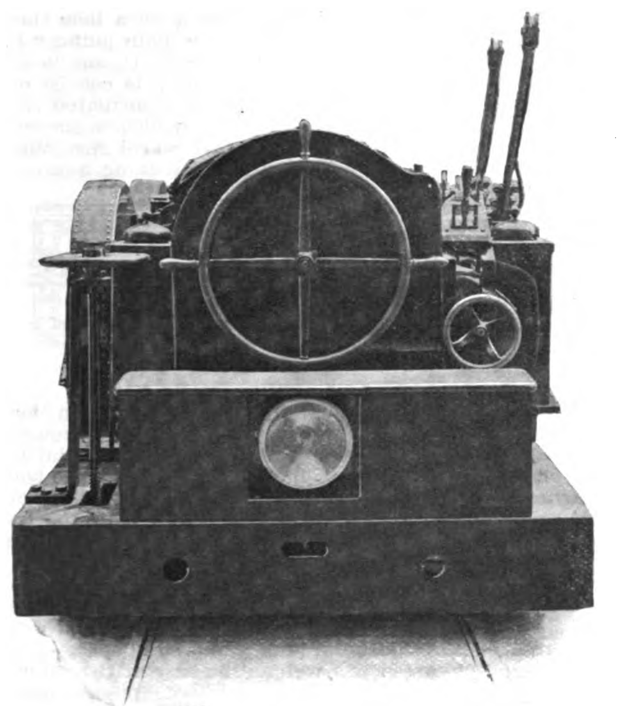


FIG. 2.—END-VIEW, SIX WHEEL MINE LOCOMOTIVE.

and electric locomotives and of the two kinds the Crozer Coal and Coke Company finally took the electric.

The requirements were a six-wheel connected locomotive, weighing about 43,000 lbs., and guaranteed to haul 40 cars up a grade of 2 per cent. at the rate of six miles an hour, and developing a drawbar pull of 10,000 lbs. using sand. Radius of sharpest curve, 60 feet; weight of rails, 40 lbs. per yard; gauge 44 inches. Locomotive to pass through an opening 6 feet 11 inches high above rail, 10 feet wide at bottom, and 8 feet wide at top.

The general dimensions and specifications are as follows:

Diameter of driving wheel	33 in.
Total wheel base	6 ft.
Extreme width, not over	6 ft. 2 in.
Extreme length over all, about	18 ft.
Weight in working order	44,000 lbs.
Extreme height	5 ft. 6 in.

Two 100 horse-power consequent pole motors, with steel fields wound for 500 volts. Gears of cast steel, acurately cut. Gear cases of sheet iron, oil tight at bottom, and completely surrounding gears. Top field with hinged lid for reaching armatures and commutators. Rings in top fields for hoisting.

Driving axles of best hammered iron with journals 5½ inches in diameter by 6½ inches long. Axles turned all over.

Driving wheels of cast-iron, spoke type, keyed to axles. Tires of open-hearth steel, 5 inches wide and 2½ inches thick.

Parallel rods of hammered iron with brass bushings and oil cups.

Crank pins of steel accurately turned and pressed into wheels with hydraulic pressure.

Frames of wrought iron, with wrought-iron jaws. Jaws protected from wear of boxes by cast-iron shoes.

Foot plates of cast-iron bolted to frames.

This locomotive has two sand boxes, front and back, two electric headlights with parabolic reflectors and brakes operated from both ends and of sufficient power to slip drivers when necessary, one electric controller operated from both ends and suitable for two 100 horse-power motors. All electrical apparatus, including rheostats, controller poles and switches, are provided to operate the locomotive. The workmanship is equal in all respects to that given to steam locomotives. All similar parts are interchangeable and all turned bolts to have a driving taper fit.

The gauge of the track being but three feet, it was impossible to get the 100 horse-power motor's dome between the wheel flanges. This fact, together with the slow speed at which the locomotive was required to develop its rated power, compelled the use of intermediate gearing.

This locomotive was built to the specifications of Mr. F. W. Darlington, who was the consulting engineer for the Crozer Coal and Coke Company. Mr. Darlington has made a specialty of these problems and it will be remembered, was engaged on the experimental work of the Pennsylvania Railroad Company on their Mount Holly-Burlington branch.

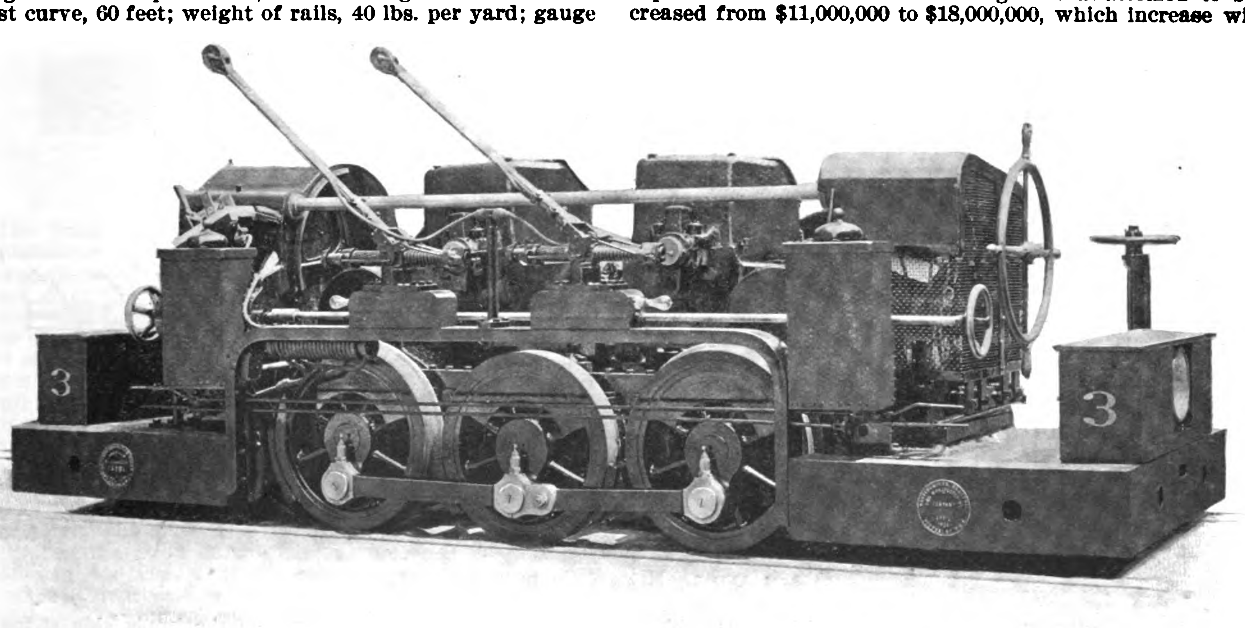


FIG. 1.—SIX-WHEEL MINE LOCOMOTIVE, 200 H. P., FOR NARROW GAUGE.

CONSOLIDATION IN CINCINNATI AND SOME RESULTS.

On July 29 the Cincinnati Street Railway Company absorbed the Mount Adams and Eden Park Inclined Railroad and the Mount Auburn Cable Railroad, and now controls and operates the various lines formerly owned by those companies. The capital stock at the same meeting was authorized to be increased from $11,000,000 to $18,000,000, which increase will be used from time to time as it is required. The elective officers of the Cincinnati Street Railway Company are as follows: John Kilgour, president and general manager; Jas. A. Collins, sec-

retary and assistant general manager; Robert A. Dunlap, treasurer; John Harris, superintendent.

The consolidation has led to a new contract between the city and the railroad, and the terms have just been accepted by President Kilgour. They are very interesting and noteworthy.

The City Board of Administration has eliminated the trouble in existence in regard to transfers. As it is now the passenger must demand the transfer upon payment of fare. Under the consolidation resolution he has three minutes in which to secure the transfer. That is, any time within three minutes after paying his fare he is entitled to a transfer. The board, in case any one has been overlooked, may within six months make additional demands in regard to transfers or make such changes as they see fit.

The Street Railway Company must within one year remove the tracks from the sidewalks on Clifton avenue and relay them in the center of the avenue and widen the roadway and set new curbs along the sidewalks and expend $7,000 in improvements on the avenue. The railroad company must pay $7,000 towards improvement of the Liberty street viaduct.

Although the rate of fare is 5 cents, the fare for children under 10 has been made 3 cents.

The inclines must sell tickets to ride on the trucks ten for 25 cents, or two and one-half cents per trip. This means much to those who simply ride to the hill top, working not far away, but down the hill.

One of the greatest advantages secured is the all-night service, which will give the suburbs continuous connection with the downtown portion of the city.

The heating of cars in the winter and the running of summer cars is provided for.

A point secured is that the extension of the franchise does not give the street railroad the privilege of a 5-cent fare for fifty years, but really only for fifteen years, when the B. of A. or the regular constituted body of the city, may consider again the question of fares.

The consolidation terms also provide for illuminated signs, and the municipal inspection of all cars. The Board of Administration can adjudge a car unfit for service and recommend such improvements on it as they think best. The new terms go into effect the middle of September.

THE MUNSON ELECTRIC CONDUIT RAILWAY.

THE Munson Electric Conduit Company have established offices at the Rookery, Chicago, to promote a new electric conduit system for railway car propulsion, and have equippeu a practical working model in their offices, consisting of 70 feet of track and an electric motor car which is exactly one-quarter the dimensions of a regular 28-foot car. The track, which is partly level, also contains a grade and a sharp curve of seven-foot radius.

The level portion of the track is submerged in water, and the car runs, stops and starts on the level (while the electrical contacts and collector are under water), without any hitch, flickering of the lights in the car or sparking at the motors. The system shows a high insulation test, and its promoters believe that it obviates all the troubles common to the overhead trolley and underground conduit systems. The seventy-foot model shows the details of the construction of the track which is adopted to either crowded city streets, suburban railways or elevated structures and steam roads. The construction is specially applicable to suburban traffic on existing steam roads, and it is sufficiently flexible to be applied even to cable road conduits. The details of the system will be unuerstood by reference to the accompanying illustrations.

The conduit consists of a wooden box placed under the rail H. Fig. 1. This conduit contains the trolley and feed wires and in street railroad construction would be placed two ieet below the surface of the street, the conduit being 18 inches deep. After the wires are in place, this box is filled with insulating material. Every few hundred feet are manholes and every 20 feet there is a switchbox, a half-section of which is shown in Fig. 1. This consists of an iron casting with a hole through the middle. Through this hole passes the main plunger B, attached to which are the two spring plungers C, one being directly opposite the other. These three plungers consist of one brass casting. Inside the main plunger and insulated from it is the brass conductor E, at one end of which is the switch contact F, and on the other the contact wheel A. When in the normal position, the coil springs J, working against the

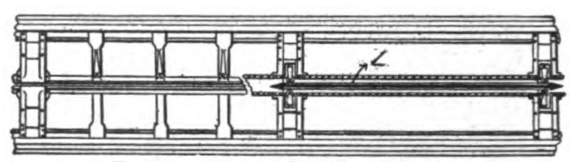
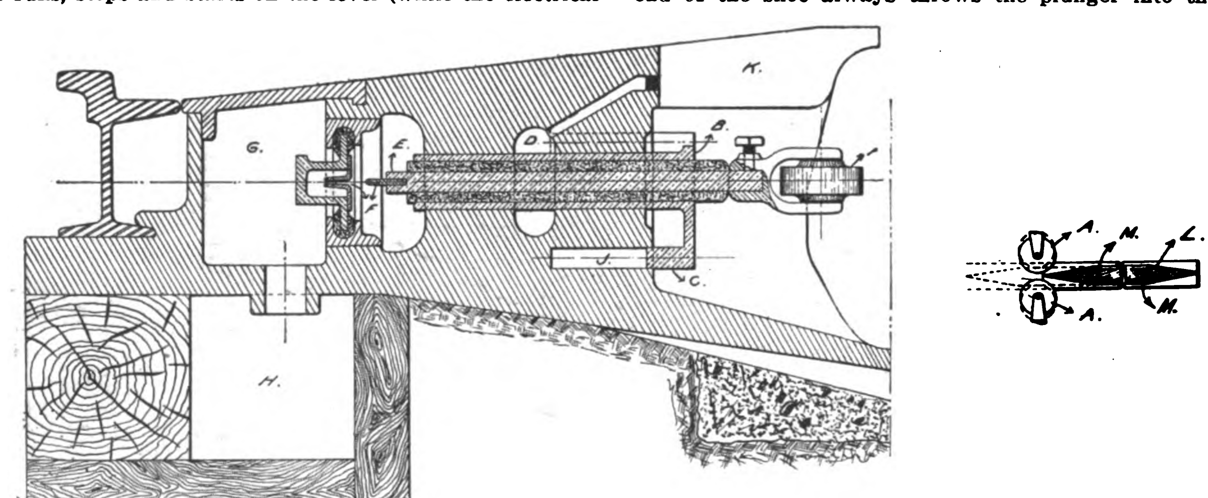


Fig. 2.—Munson Conduit Railway.

spring plungers, keep the contact points apart. When the contact wheel is pressed back, the contact points are brought together, so closing the switch. The second contact point forms a part of a small brass plug which is screwed into the body of the switchbox. This contact is insulated from the body of the switchbox and has an electrical connection with the trolley wire. After all connections are made the space marked G is run full of insulating material, so as to prevent loss of current by water collecting in the back of the switchbox. D is a recess in the body of the casting to be filled with grease for the double purpose of lubricating the plunger, and preventing water from working past the plunger into the space occupied by the contact points. I is a web on the base of the main casting and is filled around, as shown, with concrete, to assist in holding the box in place. A manhole with cover plate at K permits the contact wheel and plunger to be removed if it should be necessary.

A plan of the track is shown in Fig. 2, a portion being in section to show the shoe L, in the guide slot. The shoe is shown more in detail in Fig. 3. The contact wheels are pressed back by the brass sides of the shoe, their movement being one inch. Three inches of each end of the shoe are made of insulating material and are wedge-shaped. The contact wheels being 20 feet between centers and the shoe 21 feet long, the insulated end of the shoe always throws the plunger into the switch before contact is made between the brass side strips of the shoe and the contact wheels, so that sparking in the switchbox is prevented, and there is always an electrical connection either at one end of the shoe or the other.

It is claimed that the cost of installation will not exceed from $2,000 to $5,000 per mile more than the overhead trolley system. On elevated railroads it is said to be as cheap as the



Figs. 1 and 3.—Munson Conduit Railway.

third-rail system and on steam railroads as cheap as an overhead trolley. Existing cable conduits, it is claimed, may be changed at slight cost per mile.

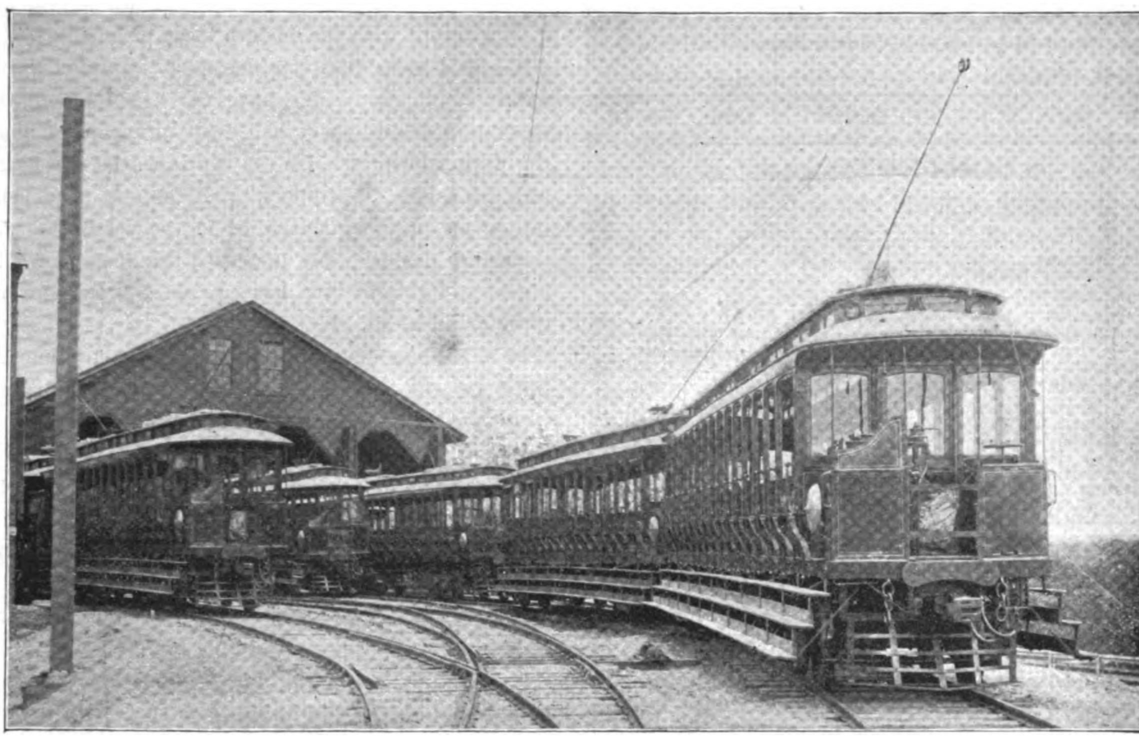
Wooden ties are used to support the rails and slot conduit for side streets and suburban work, but heavy teaming requires a different construction; hence in the streets having goods traffic iron yokes are used, in place of wooden ties, which are modeled after the best cable road practice.

OPERATION OF THE NANTASKET BEACH ROAD.

THE favor with which the electric operation of the Nantasket Beach branch of the New York, New Haven and Hartford Railroad has met from the visitors to Boston's pleasure resort at Nantasket Beach is phenomenal. It has served to confirm the predictions of the engineers of the railroad as well as of the General Electric Company, whose system was adopted. Given a comfortably seated car, open to all the cooling breezes on a hot day, unafflicted by the plague of dust from the dry track or cinders and smoke from the steam locomotive, and the prophecy that the public would avail itself largely of the privilege of riding was not difficult of realization. The traffic on the Nantasket Beach line to-day exceeds the expectations to which that of last year gave rise.

Electric operation of the Nantasket Beach branch was in June last extended as far as East Weymouth in the direction of Boston on the main line of the Old Colony Dominion. On the new line, however, the overhead conductor is not used. A third rail laid between the rails of the surface track takes the place of the trolley wire. This is the first instance of a third rail electrical conductor being laid between the tracks of a steam road, and some measure of failure might consequently be looked for. The cars have been regularly operated over it between the regular steam trains without hitch or difficulty. In the operation of the cars the change from the overhead trolley to the third rail source of power is made imperceptibly. When the car approaches the end of the trolley wire a knife switch under the hood of the car is closed, connecting the shoe beneath the car with the motor circuit. The trolley slides off the overhead wire and is hooked down, the car meanwhile continuing on its journey. On the day of the inauguration of the third rail section, several high-speed spurts were made, and these have frequently been exceeded in the actual service.

The illustration shows the car house of the first electrical division of the New York, New Haven and Hartford Railroad, adjoining power house No. 1, a corner of which is shown to the left. The car house has four pits over which the cars may be run for examination of the motors and is fully equipped with all the necessary appliances.



CAR HOUSE, NANTASKET BEACH DIVISION, N. Y., N. H. & H. RAILROAD.

LETTERS TO THE EDITOR.

PROTECTION OF LARGE ELECTRIC CIRCUITS.

In your issue of August 12 is an article, entitled "Proper Use of Safety Fuses and Magnetic Circuit Breakers," by Mr. Baxter. Some of the statements made are certainly to the point and show an appreciation of the requirements entering into the correct methods of protecting electric circuits.

Mr. Baxter's theory as to the use of generators of greater capacity than that of the engines to run them, thus overcoming troubles incident to overloading, is interesting but not practical. It is not a business proposition to put in more apparatus than is needed. Granting Mr. Baxter's point, the fluctuation of voltage in event of trouble would be about as bad in its effect upon customers as opening the circuit. Further, troubles certainly must be remedied and the juggling with relative sizes of engines and generators will not remove or correct outside troubles. The best engineering practice of to-day demands, without exception, the use of magnetic circuit breakers in lieu of the unreliable dangerous fuse metal.

WALTER E. HARRINGTON,
Elec. Engr. and Gen'l Mgr.

Camden and Suburban Ry. Co.,
Camden, N. J., August 26.

PERSONAL.

MR. W. E. DAVIS, electrical engineer and purchasing agent of the Detroit Railway, has gone to Saginaw to manage the Bearinger Electric road between that city and Bay City.

MR. RICHARD A. SMITH, electrician, has been appointed to the new position of superintendent of the City Fire Alarm and Police Telephone Systems, at Norfolk, Va., at $75 per month.

PRESIDENT S. L. PHILLIPS, of the Metropolitan Street Railroad Company, of Washington, has resigned, to take effect October 15. His management has been very successful, and in keeping with his record as a highly efficient street railway manager.

THE

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CONTENTS.

THE EFFECT OF CHANGING CONDITIONS.

IN discussing, a few days ago, the reasons for the failure of certain concerns in different lines of trade, Mr. W. J. Coombs, ex-Congressman, and an experienced man of affairs, said: "The fight against modern conditions is a hopeless one. For instance, the introduction of electricity for lighting purposes having done away with the necessity for large and expensive chandeliers, has dealt a blow to the gas-fixture business, by taking away the most profitable part of the trade. So we hear of the failure of a gas-fixture house. The combination of various classes into one large retail house has doubtless struck a blow at a great number of small retail dealers in specialties. Where one large house, with an enormous capital, deals not only in dry goods, but in hardware, crockery, shoes, books, and a thousand other articles which in old times were handled by separate establishments, it stands to reason that the day for such separate establishments is past. While this, in some respects, seems hard, no fault can be found with it, for it is in accord with the modern ideas of business."

It seems to us that this statement contains more than one wrong implication. We have not heard before that the introduction of electricity had dealt any kind of a blow to the gas fixture business. On the contrary, the gas fixture makers have all made "electroliers," and there is no evidence of any falling off in the quantity or in the costliness. The use of electricity has certainly increased the demand for light of all kinds, and this in turn has created a better demand for fixtures of all kinds.

As to the combination of several trades into one being a bad thing for the smaller producer or seller, we have yet to be convinced that anything of that nature is true or an established permanent fact. It is quite natural that where a number of small articles of one kind are made and sold, their handling should gradually settle into the care of a relatively few houses of superior capacity; but when it comes to trades very wide apart, it by no means follows that success is sure to attend their combination. Mr. Coombs would not instance Hilton & Hughes as a brilliant example in retail trade; and we ourselves will refrain from quoting the General Electric Company as an overwhelming proof of success in manufacture.

The man who is making or selling specifically the articles of a definite class, and who is giving to his business the best of his time, energy and ability, is under no real or permanent disadvantages when in competition with the man who has spread himself thin over a variety of goods. In many of the industries, patents come in to complicate the problem, but even then it has been found that genius is not a monopoly and that the very success of a new idea is the best possible invitation to hit upon something still more ingenious. The main thing for a business man or a professional man, or for a whole people, is to keep an eye on changing conditions and to live abreast of them.

ARCTIC LIGHTING.

WHEN we recall the fact that the civilized world at one time depended largely for its means of lighting upon the supplies of whale oil, obtained from Arctic waters, it is interesting to note that in these modern days, the electric light is one of the resources most prized by those who traverse the same waters in order to reach the North Pole. It would have seemed easy to capture a whale and get its oil, but the explorer finds it is better to have an electric light plant for purposes of illumination. One of the very first incandescent lighting plants was put on board the unfortunate Jeannette, and now lies on the ever silent floor of some far icy sea; but we are glad to know that Dr. Nansen in his recent voyage to the Pole found his electric plant a great comfort. This intrepid and ingenious man got within less than 250 miles of the Pole, or 200 miles further north than anybody else, and he attributes his success in no small measure to that little dynamo. To his way of thinking, heat and light were the best preventives of disease, and he determined to have plenty of them. He carried a windmill to run the dynamo, and proposed if the wind failed to operate it by human power. It has not been made known whether this became necessary, but a few storage batteries would have avoided even that necessity. At any rate, it is a great pleasure to know that his electric lighting more than fulfilled Nansen's expectations, and it is equally interesting to know that Andree counted a good deal upon the use of the telephone in connection with his balloon trip to the Pole.

MUNICIPAL WIRES.

THE increasing importance of the electrical services in the great cities is adding materially to the responsibilities of those in charge of the wires, and is also, for that matter, providing occupation for many of the younger men graduating in electricity from the colleges. Of late the tendency has been to place all the electrical departments under one common head or control, and this has been done in such cities as Chicago and Pittsburg. Whether it is altogether advisable in large cities is a question not yet settled, but it is the only policy for lesser communities, where one official can easily supervise the work directly.

With regard to Pittsburg, Mr. Morris W. Mead, the superintendent of the electrical bureau, is of opinion that the comprehensive scheme has worked well. It is interesting to note that not only are the police and fire alarm services, as well as others, concentrated in his hands, but that his bureau has of late been regularly engaged in the inspection of all new wiring in buildings and of all exterior wires operated by lighting, railway and other companies. In the last eleven months, he has had 1,339 inspections of interior work made, each requiring from two to twenty visits; and it cannot but be that such work must result in the greater security of life and property.

As an evidence of what electricity can do in the policing of a large city, it is interesting to note Mr. Mead's statement that the 185 police telephone boxes obviate the employment of about 800 men. The city could not, however, afford to hire any such number, in addition to its present force, and therefore derives from the use of the telephone that large amount of extra protection. The old-fashioned detachment of the policeman from headquarters, without means of communication, is in sharp contrast with the electrical methods which can bunch the whole police force of such a city as Pittsburg at any given point within an hour in an emergency.

THE X-RAY FURORE.

SELDOM, indeed, is an excitement seen equal to that which seized upon the world at the announcement of the discovery of the Röntgen ray. Not only were scientific circles stirred to their depths, but the public was delighted and dazed, while the newspapers found no story too wild or improbable. Wonders were rapidly piled on wonders and still the end of the sensation came not. If one daring investigator alleged that he could see through one man, next day another investigator would declare that he could see through two at once; while, not to be outdone, a third would rush into print and asseverate that he could see through three or six. Then came the killing of germs, the curing of disease and the opening up of a new heaven and a new earth.

Scientific discussion of the really great discovery of Prof. Röntgen is still going on, and work of importance is recorded from time to time, but the fantastic revelry of the imagination over the subject has come to an end, and the public wants something new to titillate its curiosity. When we come down to hard, stern fact and look at the net results up to the present time, it is seen that the X-ray has been of use to man in only one direction, namely, in surgery. It has put a new instrument of research into the hands of the doctors and has distinctly lessened the necessity for the probe and the knife, or the application of anesthetics. This is the line, then, along which to look for serious work, and it is not asking too much to expect every hospital and every physician to be equipped with X-ray apparatus or ready to avail themselves of its valuable aid.

THE STREET RAILWAY INDUSTRY.

ACCORDING to advance sheets of "Poor's Manual," just issued, the total of street railway investment in this country is $1,354,497,213 which approximates very closely to the figure of $1,375,410,172 given by the "Street Railway Journal" in August. The "Manual" gives the total length of line as 15,956 miles, against 13,176 in 1895, and the number of cars, all told, as 48,931. A few roads aggregating about 530 miles failed to report, but the remaining 15,425 miles showed a liability of $828,547,285 stock and $525,949,928 in bonds, making a total of $87,809 per mile. The "Street Railway Journal" reaches a corresponding total liability of $95,000 per mile, but the difference does not strike us as serious, or as involving inaccuracy in figures which have evidently been compiled on both sides with great care.

The broad conclusion may be reached that the liability per mile of street railway is about $90,000, as compared with the $60,000 which is the average per mile of steam railroad. We know of no statistics up to date showing how the street railways as a whole stand as to earning capacity and the payment of interest on their bonds, but it may be doubted whether the adverse times, pernicious speculation and harsh legislation have affected them as badly as the steam roads. According to the Interstate Commerce Commission report, no less than 70 per cent. of the stock of the steam roads is paying no dividends, and 17 per cent of the funded debt has not met its interest. From such a depression any industry may well pray to be delivered.

SOCIETY AND CLUB NOTES.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION.

At the meeting of the Society for the Promotion of Engineering Education, held in Buffalo, officers for the year were elected as follows: President, Prof. Eddy, of the University of Minnesota; vice-president, Prof. John Galbraith, of Toronto; secretary, Prof. C. F. Allen, of the Massachusetts Institute of Technology; treasurer, Prof. J. J. Flather, of Purdue University.

MEETING OF THE A. A. A. S. AT BUFFALO.

THE annual meeting of the American Association for the Advancement of Science took place under favorable conditions at Buffalo last week. The attendance was fairly good and a number of papers were presented in the various sections.

Among the papers offered in Section D, Mechanical Science and Engineering, were: "The most economical point of cut-off for steam," by H. T. Eddy; "On a continuous indicator for engine tests," by T. Gray; "An arrangement for using storage batteries for the automatic regulation of engine loads in power plants of variable output," by W. S. Franklin; "The better distribution of forecasts," by J. A. Miller.

In Section A, Mathematics and Astronomy, a paper was read by L. A. Bauer, on "The component fields of the earth's magnetism."

In Section B, Physics, Vice-President C. L. Mees gave an address on "Electrolysis and some associated problems in molecular dynamics." The list of papers is as follows:

"Note on the effect of odd harmonics upon the virtual values of periodically varying quantities," by Frederick Bedell.

"Electrical waves in long parallel wires," by A. D. Cole.

"Graphical treatment of alternating currents in branching circuits," by Henry T. Eddy.

"On the counter electromotive force of the electric arc," by W. S. Franklin.

"Some points in the mechanical conception of the electromagnetic field," by W. S. Franklin.

"A theory of galvanic polarization," by W. S. Franklin and L. B. Spinney.

"On the rule for the dynamo and motor," by Alexander Macfarlane.

"On the distribution of high frequency alternating currents throughout the cross-section of a wire," by Ernest Merritt.

"An experimental study of the charging and discharging of condensers," by F. E. Miller.

"The influence of a static charge of electricity on the surface tension of water," by Edward L. Nichols and John Anson Clark.

"A new alternating-current curve-tracer," by Edward B. Rosa.

"Preliminary note on a proposed new standard of light," by Clayton H. Sharp.

"Note on the duration of the X-ray discharge in Crookes tubes," by Benjamin F. Thomas.

During the week a lecture was delivered by Dr. J. W. Spencer, of Washington, on "Niagara as a timepiece," and a large party of members and friends visited and inspected the Falls and the power works.

The following officers were elected for 1895-6: President, Prof. Wolcott Gibbs, Newport, R. I.; vice-presidents, who form the chairmen of the various sections, mathematics and astronomy, W. W. Beman, Ann Arbor, Mich.; physics, Carl Barus, Providence, R. I.; chemistry, W. P. Mason, Troy, N. Y.; mechanical science and engineering, John Galbraith, Toronto, Canada; social and economic science, Richard T. Colburn, Elizabeth, N. J.; permanent secretary, F. W. Putnam, Cambridge, Mass.; general secretary, Asaph Hall, Jr., Ann Arbor, Mich.; secretary of council, D. S. Kellicott, Columbus, Ohio; treasurer, R. S. Woodward, New York. The next place of meeting was left in the hands of the council for final action.

Secretaries of various sections were elected as follows: Mathematics and astronomy, J. McMahon; physics, F. Bedell; chemistry, P. C. Freer; mechanical science and engineering, J. J. Flather; social and economic science, A. Blue.

Secretary Barnes read a resolution sent in by the nominating committee and the sub-committee appointed to select a place of meeting for the association in 1897 which acted like a bombshell exploding in the midst of the camp. The committee reported in favor of holding a formal meeting in Toronto one day next year, August 17, 1897, and recommended that at the close of the formal meeting the association meet in Toronto with the British Association for the Advancement of Science and identify itself with the sessions of that body.

After lively discussion this plan was turned down, and the matter referred back to the council.

LITERATURE.

SUBMARINE CABLE LAYING AND REPAIRING. By H. D. Wilkinson. New York: D. Van Nostrand Co. London: The Electrician Co. 406 pages. 221 illus. Cloth, 8vo. Price, $5.

It is strange, that outside books on testing, there should have been so small a literature on the subject of submarine cable work. This field of industry is one of the oldest; it has been fertile in great inventions; it has required fine engineering; it has been developed by great investments, and it has become one of the most profitable fields of enterprise. Yet it would puzzle any man to name half-a-dozen or even three first-class books, in the English language, on the submarine cable art. It is evident, therefore, that Mr. Wilkinson has had a good opportunity to "fill a gap"—not one of those imaginary voids, fictitious creations of the author's own ignorance, immaturity and inexperience, but a real necessity on the part of those who wish to learn. Careful perusal of the work shows that Mr. Wilkinson has done a real service and has, in a masterly manner, put together nearly all that is valuable, and much that before was not public property, in regard to this important subject.

The book is divided into four sections, which, rather oddly, are called chapters. As the whole book consists of but 406 pages, and as two of the chapters are each over 120 pages in length, it would seem that a finer subdivision might well have been attempted. As a general thing, the reader is helped by the division into frequent chapters. The objection we would raise, is, however, offset by the resort to numerous sections, nearly sixty in all; as well as by a very careful and complete list of illustrations and an excellent index. One other general criticism that suggests itself is the somewhat Hibernian fashion in which the book begins with the repairing cable ship and winds up with the laying of cables, an arrangement that strikes one as being wrong-end-to. It is possible, however, that this is due to what may be termed the evolution of the book, namely, that it began as a series of articles on one branch of the subject and grew into a manual of the whole art.

There is little that is historical or reminiscent in the book, although we are very glad to see preserved in it some early pictures of submarine work when it had a fuller spice of novelty and danger than it knows to-day. Mr. Wilkinson devotes himself almost entirely to the practical side of the subject, and discusses every topic with a clearness and an exhaustiveness that leave nothing to be desired. Especially worthy of commendation are the clear drawings and diagrams scattered profusely throughout the text. The book is based essentially on English practice, and has nothing to say of American methods, there being only one or two branches in which work done on this side demands consideration, and those hardly within the scope of the author's plan.

We have spoken of this book as covering the ground, but do not intend the remark to imply that it includes methods of operation. This is, indeed, a subject by itself, and worthy another volume, quite as large, from the same hand. Nevertheless, many interesting points do come under treatment, of that nature, in connection with testing, and Mr. Wilkinson has presented an admirable chapter on the localization of faults. To a great many, that chapter will be the most useful part of a book every page of which is interesting and instructive.

THE CHICAGO MAIN DRAINAGE CHANNEL.—By C. S. Hill, C. E. Asso. Ed., New York. Engineering News Publishing Co., 1896. Cloth. Quarto. 129 pages. 105 illus. Price, $1.50.

One of the greatest engineering enterprises to be carried out recently in the United States is the excavation of the 28-mile drainage canal from Chicago to Lockport, Ill., with the object of carrying the dilute sewage water of the Chicago River westward into the Mississippi and away from the city's water supply in Lake Michigan. This work has been in hand for about four years and is now, we understand, practically complete. About 40,000,000 cubic yards of earth and rock have been dug out and moved by methods and appliances often strikingly original. All the branches of the work were very ably dealt with by Mr. Hill in a series of articles for his journal, and these have now been republished, constituting a most interesting and valuable monograph. The subject is one having many points worthy the notice of electrical engineers. It will be remembered that it has been said that 80,000 horse-power can be reclaimed electrically by the fall of the water between Joliet and Lockport, while, on the other hand, there has been the discussion as to whether the level of the lakes and the outflow at Niagara might not be reduced by this wholesale diversion.

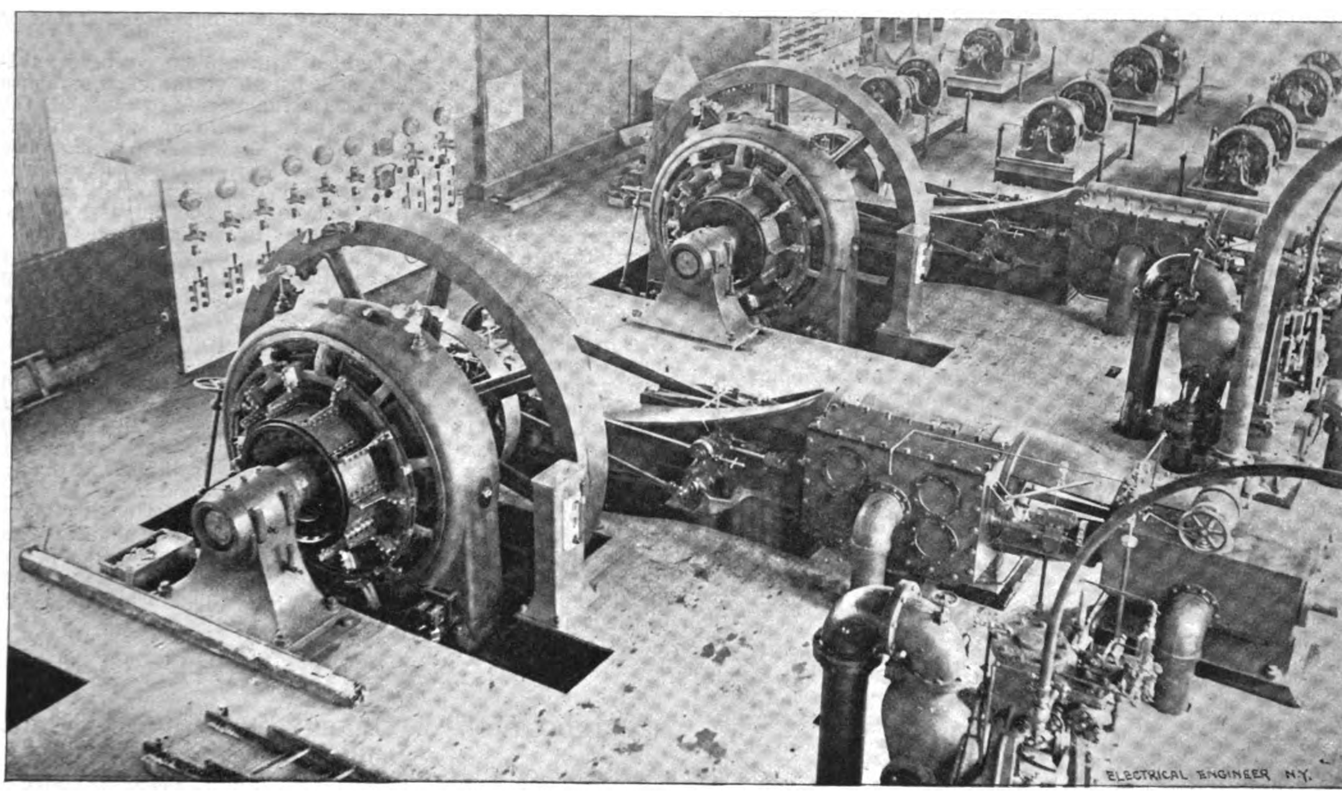
ELECTRIC LIGHTING.

ELECTRICAL PLANT OF THE DUQUESNE STEEL WORKS AND BLAST FURNACES.

THE Carnegie Steel Company, Limited, have recently put into operation at Cochran, Pa., about 12 miles from Pittsburg, an extensive new blast furnace plant on property adjacent to their well-known Duquesne Steel Mills. Several excellent features are noticeable in connection with the electrical plant, the function of which is to supply light and power to the steel mills, six furnaces, and the various buildings and yards appertaining thereto; an area of over 100 acres.

THE ELECTRIC POWER HOUSE.

This plant is situated in a separate brick building, 200 x 50 feet, having a steel shell. The building is divided into three parts; the central 120 feet, contains the electrical machinery and switchboards, which will be described in detail below. The 40 feet at the northern end contains the office of the superintendent of the electrical department and a storeroom for wire, spare parts, etc. The 40 feet at the southern end comprises the machine or repair shop, which is equipped with lathes, drill presses, milling and slotting machines, etc., all operated from a shaft driven by means of a 10 horse-power multipolar shunt wound motor. A 10-ton electric traveling crane runs the entire length of the building. The great advantages of such a crane and repair shop are obvious.



DYNAMO ROOM, DUQUESNE FURNACE AND STEEL WORKS.

GENERATORS.

The photograph illustrated above is a view of the central portion of the power house. In the foreground are two 500 horse-power, 250 volt, direct current, 10-pole generators, each direct connected to a Buckeye tandem compound condensing engine, 18 inches and 32½ x 33 inches, operating at 130 revolutions per minute, and exhausting into a standard Blake condenser. These generators were built by the Westinghouse Electric and Manufacturing Company, and represent their latest development in dynamo design and construction. The field poles are built up of laminated steel and they are cast into the yoke, which is divided vertically as shown. The armature core, which is pressed and keyed upon the engine shaft, consists of laminated steel discs slotted around the periphery. When the discs are superimposed upon each other, they form grooves into which the conductors are placed. These conductors are composed of rectangular copper bars, shaped upon molds and thoroughly insulated before being placed upon the core. The brush holder mechanism is supported by brackets projecting from a cast-iron ring secured to and supported by the field yoke, as shown. Each machine has 10 brush arms, each carrying 5 carbon brushes. These generators are operated in parallel and supply power to a large number of direct current 220-volt motors used for various purposes throughout the plant.

In the background of the same photograph are shown six direct constant current, 60-light arc dynamos, which supply current to arc lamps in the various buildings and yards. These machines are direct connected by flexible insulated couplings, to six 50 horse-power shunt motors, which are also operated by power from the generators described above. The exciting current for the arc machines is also taken from the same generators.

The illustration also gives a view of these arc machines and their driving motors. The arc machines are symmetrically located on each side of an aisle, which is directly opposite the arc switchboard, this arrangement being very convenient for the attendant.

Each of these units (arc machine and motor) is mounted upon a separate foundation, as shown. On a similar foundation is a 45 kilowatt, 7,200 alternation, single-phase generator (not shown in the illustration) which is also direct connected to a motor and excited by current from the large generator. This machine is used for supplying current to about 900 incandescent lamps distributed in the various buildings.

SWITCHBOARDS.

A white marble switchboard, supported by an iron frame work stands back of and between the two large direct current generators. This is the power board and upon it are mounted the necessary switches, circuit-breakers, ammeters, voltmeters, and rheostats, for controlling the two generators; it consists of two generator panels, one main panel and six feeder panels. All the connections are made on the back of the board. A large single-pole switch, mounted on an iron pedestal, near each of the direct current generators, is for the equalizing circuit, which is carried directly from one generator to the other, under the floor.

The arc switchboard consists of six marble panels, the three on the right containing the circuit-breakers and switches for controlling the six direct current motors, while upon the other three are mounted the ammeters, circuit-breakers, plugs and plug receptacles for controlling the arc machine and arc cir-

cuits. By means of the plugs any one of the machines may be connected to any of the feeder circuits. All wires from the arc machines and their driving motors are carried through hollow posts to a pine switchboard situated under the marble one in a light, dry cellar, the floors of which are concreted. No so-called "temporary work" can be found in the plant, the entire installation having a substantial and permanent appearance.

No wires are visible on the ceiling or walls of the building, except at the northern end, where they are brought from the cellar in two groups, positive and negative, pass up the wall and through a circular gable window to a line of steel poles, 50 feet in height, upon which they are carried through the yards and to the buildings. The arc machines, alternating current generators, marble switchboard and all the motors installed in the power house were also manufactured by the Westinghouse Electric and Manufacturing Company.

GENERAL DESCRIPTION OF PLANT.

It was originally intended to confine this article strictly to the electrical features of the plant, but a very brief description of the operation of the entire plant will be given here, as it may be interesting to readers who are unacquainted with the work carried on in such an establishment, and will also be of assistance in understanding the nature of the work to be performed by the electrical apparatus.

The Duquesne Steel Mills have been in operation for several years, but until this summer there have been no blast furnaces in connection therewith, and the iron used in the process of making steel billets was obtained in the form of pig iron. The blast furnace plant, when complete, will consist of six furnaces; the first two of these were placed in operation, or "blown in," in June of this year. The other four are rapidly nearing completion.

At the foot of the furnaces is an immense "stock-pit," 30 feet deep and 230 feet wide, where the ores, coke and the other materials used in charging the furnaces are stored.

A new and improved method of carrying the materials to the top of the furnaces has been employed. A track supported by iron structural work extends from the stock-pit to the top of each furnace and the cars containing the materials are hauled up and when just over the bell, the load is dumped. When the bell is sufficiently charged it is lowered, and the charge falls to a second bell, the first is then brought back into position and the second bell is lowered, thus dropping the charge into the furnace. This prevents the escape of hot air and gas when the furnace is being charged.

There are eight large heating "stoves" for each two furnaces; these stoves are supplied with hot gas from the furnaces and their function is to heat the air which is pumped by 1,800 horse-power blowing engines built by the E. P. Allis Company. There are five of these engines installed in one building, two are used for each furnace and one held in reserve. These engines compress the air to from 15 to 25 lbs. per square inch, it then passes through the "stoves" and is heated to a very high temperature after which it is forced into the furnaces. The gas from the furnaces is also used to operate the boilers, the capacity of which, when completed, will be about 18,000 horse-power; 6,000 horse-power for each pair of furnaces. The boilers are of Babcock & Wilcox manufacture.

Ordinarily the metal is drawn off the furnaces and run into large ladles (mounted upon cars) and taken directly to the Duquesne Mills, where it is mixed and then run into converters and used in making steel billets. On Saturdays and Sundays, when the converters are not in operation, the iron is drawn from the furnaces into the casting house, where it is run into "sows" 26 feet in length. These "sows" are taken to a metal breaker and broken up and later sent to be remelted in the converters.

PUMP HOUSE.

In a separate building near the electric power house, are installed the engines for pumping the immense quantity of water required in the plant from the Monongahela River into a huge stand-pipe 158 feet in height. There are five of these engines built by Wilson & Snyder, of Pittsburg, and the pumping capacity of each is 5,000,000 gallons per day.

ELECTRIC CRANES.

There will be over 40 Morgan electric cranes in the plant; all of these are driven by 220 volt direct-current motors manufactured by the Westinghouse Electric and Manufacturing Company.

Each of the six casting houses is equipped with two 10-ton three movement electric traveling cranes. A 10 horse-power multipolar motor, enclosed type, is used for the hoist, 10 horse-power for bridge travel and 3½ horse-power for carriage. The hoist and carriage motors are equipped with automatic electric brakes, the bridge motor with powerful foot brakes; an arrangement which permits a very accurate movement in each direction. These cranes carry the pig iron to the metal breaker previously mentioned. Each blowing engine house is provided with a 25-ton three movement crane of 61 feet span; a 20 horse-power motor being used for hoist, 5 horse-power for carriage and 30 horse-power railway type motor for bridge travel. Automatic electric brakes and foot brakes are supplied as on the cranes in the casting houses.

A 50-ton electric crane of a special type built by the Morgan Engineering Company, is erected over the metal mixer. It is a four movement crane; two hoists, one carriage and one bridge movement. The motors are: 100 horse-power for main hoist, 20 horse-power for auxiliary, 10 horse-power for carriage and 30 horse-power railway type for bridge.

By means of this crane the molten metal is poured from the ladles into the metal mixer. In this way metal from several different furnaces is mixed together before being run into the converters. There is a 10-ton electric crane of 50 feet span installed in the pump house. The motors thereon are 10 horse-power for hoist, 10 horse-power for bridge and 3½ horse-power for carriage.

OTHER USES OF ELECTRIC MOTORS.

The metal breaker is direct connected to a 60 horse-power multipolar shunt wound motor. The breaker, which is provided with a flywheel four feet in diameter, is fed from a long table driven, through suitable gears, by a 30 horse-power railway type Westinghouse motor. Cranes are used to lift the metal to the table. This apparatus can handle over 100 tons of pig iron per hour.

Each casting house is provided with a 5-ton conveyer; this is a carriage running the whole length of the casting house and thence to the stock yards. Its function is to carry all the scrap iron to the foot of the furnace hoist, from where it will be taken to the top of the furnace again. A Westinghouse railway type motor moves this conveyer, and, although working day and night in an extremely warm and dusty atmosphere, it has proven entirely successful. The operator on the conveyer is protected from the heat by an iron cage.

Over the ore stock yard are three electric traveling bridges of 260 feet span. These were constructed by the Brown Hoisting and Conveying Company, of Cleveland, Ohio, and are the largest ever built for the purpose. The carriages are driven by steel ropes, all the machinery, such as drums, clutches, etc., being mounted on the bridge. Two 100 horse-power Elwell-Parker shunt motors are direct connected to the drums and enable the operator to move the bridge, carriage and hoist at the same time. The purpose of these bridges is to unload all the ores needed for the furnaces. A 20 horse-power shunt motor drives the crushing machines in the ore sampling department, and a 2 horse-power motor is used in the laboratory. In fact, electric motors are in use in almost every part of the plant for a large variety of purposes. The electrical apparatus is giving complete satisfaction and the superintendent of the electrical department is to be congratulated in having under his charge one of the largest and most complete isolated plants in the country.

NEWS AND NOTES.

ELECTROCUTION MACHINERY WANTED AT COLUMBUS, O.

Warden Coffin and R. P. Green, superintendent of electricity, have issued circulars asking for bids from the various electrical manufacturers for the necessary machinery for lighting the prison and at the same time to be used for electrocutions. The bids will be opened on September 4. The specifications call for one compound wound alternating dynamo with exciter, with a capacity of from 30 to 50 kilowatts at 2,000 volts. Alternations not to exceed 16,000 per minute, nor less than 7,200. The dynamo to be mounted on a cast-iron sliding base frame and provided with belt tightener. The armature of said machine to be iron-clad type. Both the alternator and exciter to be provided with self-oiling bearings with oil rings.

In addition to the above one alternating current station armature, one alternating current voltmeter, blocks, arresters, switchboard, converters, etc., are required. Contractors are required to guarantee the machinery for two years, and the committee reserves the right to reject any or all bids.

AMERICAN ELECTRICAL PLANTS FOR THE FAR EAST.

A large quantity of American electrical goods and apparatus has found its way to the Far East, and the market is one that appears to have a capacity for rapid growth and development. The firm of Bagnall & Hilles, of Singapore, Straits Settlements, and Yokohama, Japan, has been giving its special attention to this field, and the results are already of a very hopeful and promising nature. One of its recent contracts of

more than usual interest is that made with the Sultan of Koetei, one of the Straits potentates, who has built a new palace and who wants the best electrical plant to be had. Messrs. Bagnall & Hilles are doing what they can to gratify this laudable ambition. The palace will be fitted throughout with Habirshaw wires and cables, and the other parts of the equipment are to be of equally high standard.

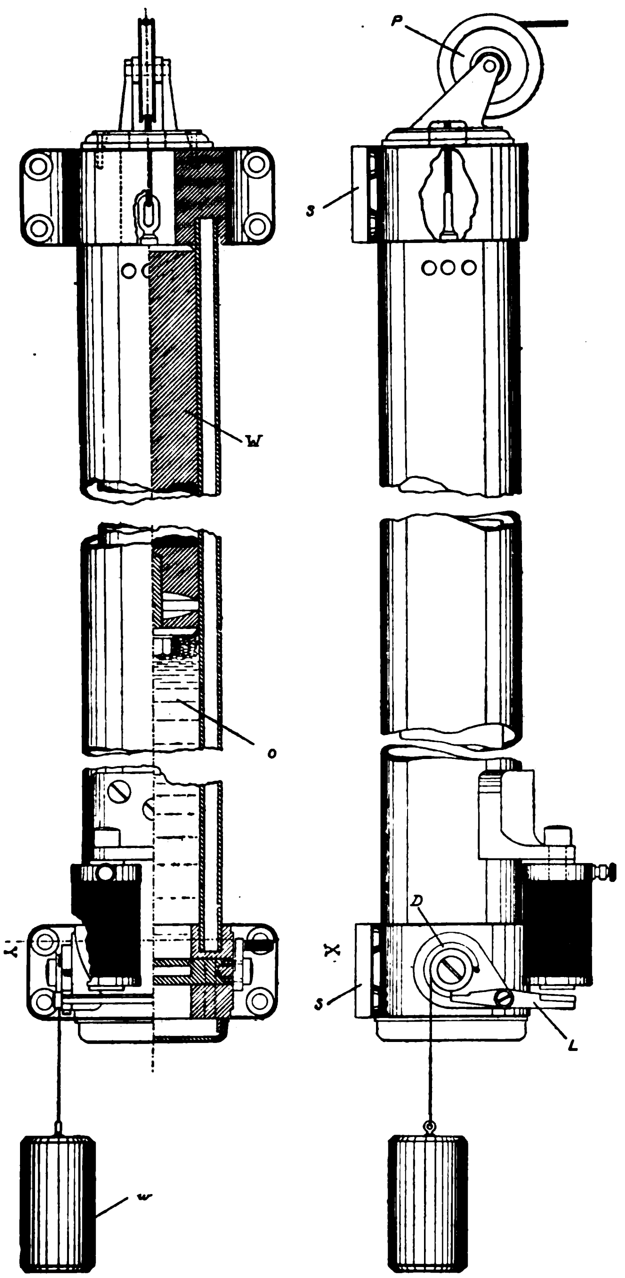
MISCELLANEOUS.

AN ELECTRICALLY CONTROLLED WEIGHT.

BY

Ernest K. Adams.

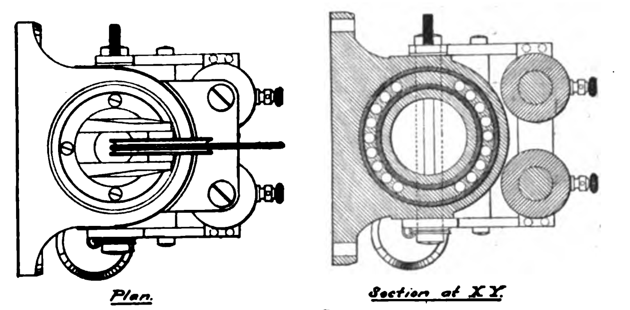
As its name implies, this device is designed to store up a small amount of energy by means of a weight which can be electrically set free. It can be applied to a variety of uses, among which are, the starting or stopping of machinery, operating those apparatus which are used in connection with fire departments, opening or closing doors, windows or registers, in fact, in any place where a small amount of work is to be done on the closing of a circuit.



METHOD OF ELECTRICALLY CONTROLLING A WEIGHT.

It consists of two tubes, supported at either end by a brass casting, having holes drilled in it for fastening the arrangement to the wall. In the interior of the inner tube a weight of a size suitable for the work in hand slides smoothly and at the same time fits tightly enough to prevent the oil, which is in the lower portion of the tube, from passing up around its sides. When the device is set, this oil cannot flow through the holes drilled in the lower support, into the jacket between the tubes, on account of a valve being closed. A small weight, sufficient for turning this valve, is fastened by a cord to a pulley on the valve rod. When a current is sent through the electromagnet the armature lever moves and, becoming disengaged from the slotted disc back of the pulley, allows the small weight to pull the valve open.

The oil has easy access now to the jacket outside, and the working weight descends, performing whatever work that may be desired. A pulley at the top, may be turned around at any angle, permitting the cord to run smoothly. When it is desired to set the apparatus, this weight is drawn to the top by pulling the cord. This causes the oil to resume its former position, air coming in from outside through several groups of holes at the top of the outer tube. As soon as the weight is in the desired position, the valve is turned by the small handle on the right, until the armature lever drops into the slot in the disc. The device is now set. By using a valve, a minimum current may be employed to set free a comparatively large weight.



PLAN AND SECTION.

THE METRIC SYSTEM IN ENGLAND.

It is stated on good authority that according to a strict interpretation of the law in England it is at present actually illegal to possess a weight or measure on the metric system. A contemporary in discussing this says that in the piecemeal way in which legislation is effected in that country it is quite possible that this may have been brought about without anybody knowing it. If so, it is appalling to think of the august institutions that have been encouraging this illegality. Most people, including the writers of some text-books, thought the metric system was legalized years ago.

NOVEL ELECTRICAL EXPERIMENTS.

The London "Electrician" states that at a special meeting of the South African Philosophical Society, held on the 2d ult., a lecture on the above subject was delivered by Mr. A. P. Trotter, Government Electrician and Inspector. Towards the end of the lecture the lecturer rang up the Capetown Telephone Exchange, and asked if any of the longer post office telegraph lines were clear. The Port Elizabeth line was then connected up, and by means of a Wheatstone bridge on the lecture table, the resistance of the line was measured. The lecturer then observed that, with the extremely sensitive instrument used in the Government Electrical Laboratory, it was not necessary to use ordinary electric batteries for signalling to such a distance as to Port Elizabeth. He disconnected the battery, and, plunging a steel knife and silver fork into an orange, sent signals by means of the feeble current thus generated. He then asked the front row of the audience to join hands, and, putting them in the circuit, sent signals through their bodies to Port Elizabeth and back by means of the orange cell. As a concluding experiment an omelette was made "under some disadvantages," and the cost of the electrical energy was stated to be only 1d.

WATER JETS AS CONDUCTORS.

Reports have been heard from time to time concerning firemen who have received electric shocks which were supposed to be communicated from a fire engine hose. Considering what a particularly good earth a fire engine must have in its suction pipe it seemed unlikely, but it appears that so far as alternating currents are concerned the matter has been already determined experimentally by Professor Slaby, of Berlin. The

overhead conductors of a 10,000-volt power transmission line were used for the experiment. A voltmeter was connected between the metal mouthpiece of the water hose and the earth. On turning the water on to the live conductors no flow of current to earth was noticeable.

GUTMANN'S METHOD OF CHANGING FREQUENCY.

A METHOD of changing the frequency of periodic currents has been designed by Mr. Ludwig Gutmann by means of which periodic currents may be transmitted to the place of consumption and there be changed in frequency to suit the requirements of any particular case; that is, an alternating current may be transformed into one having a greater or less time period than the original current.

The apparatus by means of which this is accomplished is ex-

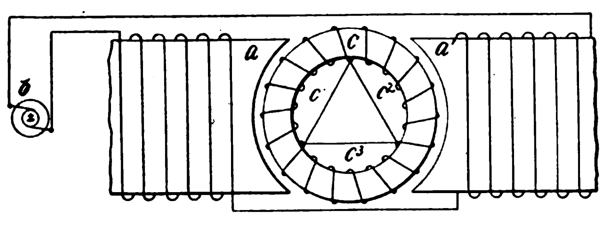
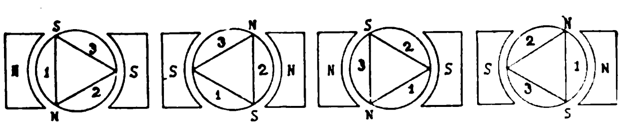


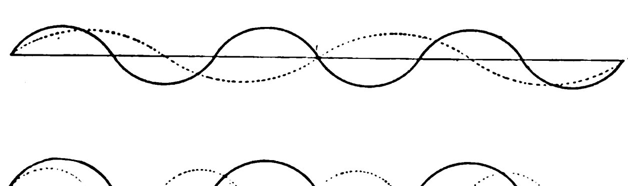
FIG. 1.

plained by reference to the following illustrations: Fig. 1 shows a diagrammatic view of the motor and Figs. 2-5 show the armature in four positions during a revolution. In Fig. 1 the field magnets a, a' are excited by a current from an alternating current generator b, thus producing an alternating magnetic field. An armature c rotates within this field, having three coils c'c²c³ cross-connected so as to form three subcircuits. If the armature be started the alternating current generated in any one of the three coils will have a frequency different from that of the current exciting the field. In Fig. 2 the coil 1 stands opposite a north pole, and at the end of one-sixth of a revolution it has advanced to the position shown in Fig. 3, the pole to the right now being of north polarity, the field strength having changed through half of a complete period, or 180 degrees. At the end of one-third of a revolution coil 1 has advanced to the



FIGS. 2, 3, 4 AND 5.

position shown in Fig. 4 the pole to the left now being north, the field strength having changed through a complete period, or 360 degrees. At the end of three-sixths of a revolution of the armature-coil 1 stands again in front of a north pole, as shown in Fig. 5. The current induced in 1 has therefore passed through one complete cycle, while the field strength inducing the current has passed through one and one-half cycles. The ratio therefore of the frequency of the current induced in coil 1 to the frequency of the field, or, what is the same thing, the frequency of the current exciting the field, will be as one and a half to one, or as three to two, so that if the frequency of the original current be sixty per second, the frequency of the induced current will be forty per second. If, instead of inter-

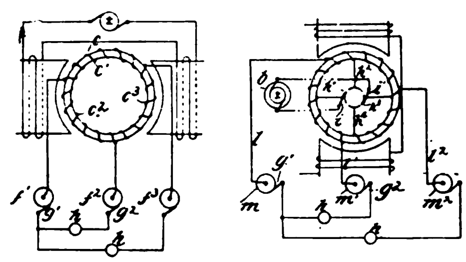


FIGS. 6 AND 7.

connecting the winding, as shown in Fig. 1, the ends of the coils c' c² c³ be connected with collecting rings f' f² f³ and brushes be placed upon any two of the collecting rings, an alternating current possessing the altered frequency may be collected, and a motor h, connected in circuit between the brushes, as g' g², will be traversed by the current of altered frequency.

In Fig. 9 is illustrated another form of apparatus for producing the same result comprising an armature the coils of which are connected with the commutator-segments h' h² h³ h⁴, upon which bear brushes i i', connected in circuit with an alternating current generator b. Three equidistant points in the winding are connected by the conductors l l' l² with collecting rings m m' m². If brushes be provided in connection with any two of the collecting rings, an alternating current of altered frequency will be collected. Thus the motor h, connected between the brushes g' g², will be traversed by the alternating current of altered frequency.

In Fig. 6 the curve of the alternating current the phase of



FIGS. 8 AND 9.

which is to be altered is shown in full lines, while the resultant current of two-thirds the frequency, as shown in connection with Figs. 2 to 5, is plotted in dotted lines.

In Fig. 7 is shown a similar curve, and a curve of greater frequency produced therefrom, the method being equally applicable to increasing or decreasing the frequency. As here shown, the frequency is increased in the ratio of three to four. It is evident that the resultant current may have a period equally divisible into the period of the current to be altered, that is, a period of one-half or one-third, or it may have a period forming a multiple of the period of the current to be altered, as twice or three times, or the periods may bear a harmonic relation, as three to two or four to three.

ALTERNATE CURRENT TRANSFORMERS[1]—III.

BY DR. J. A. FLEMING, F. R. S.

We shall consider in a later lecture the disadvantages of a small-power factor. Meanwhile, it may be said that a small-power factor in a transformer, when taken at no secondary load, is always an indication of large magnetic reluctance in the magnetic circuit, and hence open iron circuit transformers have always small-power factors. The primary and secondary coils, having been placed upon the core and insulated from one another, the transformer is put into an iron case, which is constructed to be water-tight. Many manufacturers include in the same case porcelain plates or terminals, to which they attach the extremities of the primary and secondary coils. This, however, is not so good a plan as connecting by a highly insulated joint the extremities of the primary and secondary coils to highly insulated cables, which are brought out through watertight glands in the iron case, any necessary connections to fuses or switches being then made outside. In the design of large transformers, one important consideration is getting rid of the heat. A transformer ought never to rise above 100° Centigrade under any conditions of use, and for every watt which is lost in hysteresis and by copper resistance at least 3 to 4 square inches of cooling surfaces must be provided. In the case of very large sub-station transformers, it has even been found advantageous not only to leave ventilating spaces in the core, but to force a draught of air through the transformer to keep it cool. In some cases a highly insulating oil is put into the case, but the insulation of the transformer must be good enough to work without it. The use of the oil is merely to keep out damp air, and even then it is not always successful in preventing break down. The notion that oil could be used as an insulation for transformers, which would heal up again after the passage of a spark or arc, was not confirmed by experience. As regards the general design of transformers, the battle of open versus closed iron circuit transformers was fought out and decided long ago. Open circuit transformers—such as the Hedgehog transformer—have no advantage over the closed iron circuit transformer in respect of core loss per kilowatt output and they have a decided disadvantage in a smaller power factor. Moreover, in a closed iron circuit transformer, as the transformer is loaded up, the power factor very soon reaches unity; the curves in Fig. 30 show the manner in which the power factor of several different types of transformer varies as the transformer is loaded up. In a good closed iron circuit transformer, with small magnetic re-

[1] Society of Arts Cantor Lectures.

luctance,' a very little loading of the secondary circuit brings the power factor up to unity. In the case of a 6 kilowatt Mordey transformer I found that, loading up to 1-60th of full load, brings the power factor up to unity. The advantage of large power factor means we have a small root-mean-square value in the magnetizing current at no load, and, therefore, a small heating loss in the main supplying the current of that transformer. When the transformer is at work we not only have energy losses going on in the iron, but, at the same time, we have energy losses in the copper, called the copper losses, which are due to the resistance of the copper circuit. It can be

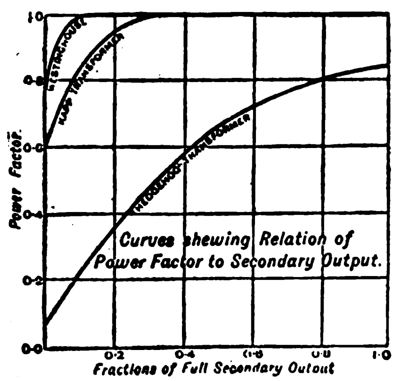


FIG. 30.

shown the most advantageous ratio between the copper losses and the iron losses is to so construct the transformer that at full load the total copper losses are equal to the total iron losses. In very large transformers, where the secondary circuit consists of very thick copper bands or wire, if magnetic leakage exists to any sensible extent, we may have eddy current losses set up in the copper circuits, and this, in addition, may be a source of energy waste. The copper resistance operates not only to cause a large energy loss, but partly to account for what is called the secondary drop of the transformer. If a transformer is connected to a constant potential primary circuit, and if the secondary circuit is gradually loaded up, the potential difference between the secondary terminals is less when the transformer is fully loaded than it is when the transformer is on open secondary circuit. This difference is called the secondary drop. This drop is due to three causes—firstly, the resistance of the primary circuit; secondly, the resistance of the secondary circuit, and, thirdly, to magnetic leakage. As far as regards the copper resistance, we can calculate the secondary drop by the following formula:

$$\text{Secondary drop} = \frac{100 \times (C_1 - \textit{mag. cur.}\ R_1)}{E_1} + \frac{100\, C_2 R_2}{E_2}.$$

Where C_1 is the R.M.S. of the primary current.
C_2 is the same value for the secondary current.
R_1 is the resistance of the primary circuit.
R_2 is the resistance of the secondary circuit.
E_1 is the difference of potential between the primary terminals.
E_2 is the difference of potential between the secondary terminals.

taken when the transformer is on open secondary circuit, and the symbol mag. cur. stands for the magnetizing current of the

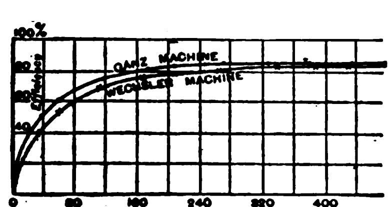


FIG. 31.—EFFICIENCY CURVES OF TWO TRANSFORMERS OFF TWO ALTERNATORS.

transformer—that is, the primary current when the transformer is on open secondary circuit.

This formula, however, only gives us that part of the drop which is due to the copper resistances; the actual observed drop would be greater than this by an amount due to magnetic leakage.

In dealing with the testing of transformers in our next lecture, we shall discuss the method by which this drop may be measured. In considering the action of transformers, it is important to notice that the iron core loss of the transformer at no load, are all greatly affected by the form of the curve of primary electromotive force. It is the custom sometimes to speak of the core loss of a transformer as if it were a quantity inherent in the transformer itself, and which could be exactly specified for any particular instrument. As a matter of fact, this is not the case. Experiments carried out with different transformers worked on different alternators by Dr. Roessler in Germany, and by myself in England, have abundantly demonstrated that the form of the curve of primary electromotive force has an immense influence on all the above-mentioned quantities. Dr. Roessler employed two machines—one a Wech-

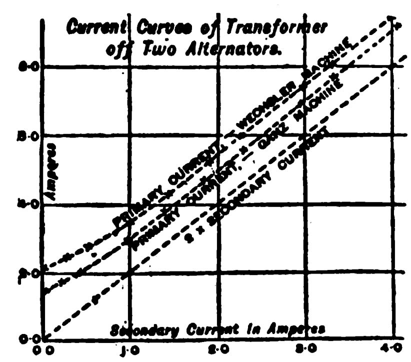


FIG. 32.

sler and the other a Ganz alternator. When these machines were running on open circuit, the Wechsler alternator gives a curve of electromotive force which has a well-rounded form; whereas the Ganz machine has a curve of electromotive force which has a very sharp or peaked form. The machines I chiefly employed in my own experiments were the Mordey alternator, the Thomson-Houston alternator and a Ferranti machine. The form of the curves of electromotive force of the first two named machines, under various conditions, have been shown in Lecture I. The general effect of all these experiments has been to demonstrate that when a transformer is worked off an alternator giving an electromotive force curve with a very sharp or peaked form, the effect of this is to make the iron core loss less, and the secondary drop greater than it is if the same transformer is worked off an alternator having a curve of electromotive force with a rounded or square-shouldered form. If, therefore, we draw an efficiency curve for a transformer, that efficiency curve giving the efficiency—that is to say, the ratio between the watts delivered from the second-

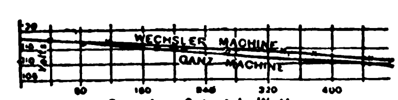


FIG. 33.

ary to the watts taken in on the transformer circuit—and express this efficiency in terms of the fractions of the secondary load of the transformer, the form of that efficiency curve will be affected by the nature of the machine which is supplying the primary current. In Figs. 31, 32, 33, are shown curves illustrating the effect of the employment of different alternators on the same transformer in affecting the efficiency, primary current values and secondary drop of any given transformer, when taken on open secondary circuit.

For fuller information on this point the reader is referred to the treatise on the "Alternate Current Transformer"[1] (Vol. I., Chap. vi., new edition) by the present writer, which will supply more details on this question than we have space to consider here.

ELECTRIC LIGHT POLE CAUSES TROUBLE.

The method of placing arc lamps in the center of a wide street gives a good distribution of light and at the same time a pleasing effect. This necessitates a refuge round the base of the lamp, which is also a great convenience for foot passengers. A new aspect of the case is reported in England, where, to save expense, the lamp on one of these refuges has been switched out at a certain hour each night. No less than three hansom cabs have collided with the obstruction. The first case was tried, and the judge held that the Vestry had a perfect right to extinguish the lamp. The jury, taking, perhaps, the common-sense view of the matter, gave a verdict for the

* "The Alternate Current Transformer in Theory and Practice." 2 vols. The Electrician Printing and Publishing Company, 1 Salisbury Court, Fleet street.

cabby, which the judge did not allow. The case is under appeal. From the recommendation of the electric lighting committee to the Vestry, we see that the Vestry is advised to stick to its guns. It has been suggested that a few incandescent lamps grouped round the lamp column would be the best way to check the series of accidents.

ROENTGEN RAYS.

WAVE LENGTHS OF ROENTGEN RAYS.

A SUMMARY of the researches on Röntgen rays published in "Nature" gives the following information in regard to the experiments to determine their wave length:

An important point in connection with the debated nature of Röntgen rays is the determination of their wave length, which has been successfully effected by Dr. L. Fomm, of Munich (Sitzb. der Bayerischen Akademie, xxvi. ii.). As these rays show no measurable reflection or refraction, the only way available was by diffraction. The Röntgen rays emanating from a large Hittorf tube were made to pass through a brass slit 0.5 mm. in breadth, and, after being diffracted by a second slit, were received on the photographic plate. The width of the second slit could be varied from 0.1 mm. up to 2 mm., and with the former width an exposure of fifty minutes was required. As long ago as March last Dr. Fomm obtained photographs showing interference bands, thus affording proof of the undulatory nature of Röntgen rays. By starting with a very narrow slit and gradually increasing its width, the interference lines approach closer together, until a dark line—the first minimum—appears in the center. As the opening becomes still wider, this minimum gives place to a maximum with two minima, one at each side, and so on, and by means of Lommel's formula, the wave length can be determined from this phenomenon. Dr. Fomm obtains $\lambda = 0.000014$ mm., so that the wave length is about fifteen times smaller than the smallest wave length hitherto observed in the ultra-violet. Owing to the difficulty of determination, Dr. Fomm regards this number as giving the upper limit rather than the exact measure of the wave length of the observed rays. Meanwhile MM. G. Sagnac, L. Calmette, and G. T. Lhuillier have published investigations in the same direction (Comptes rendus, cxxii. 13 and 16). M. Sagnac uses a wire grating, and from a scarcely measurable diffusion of the image of the slit he obtains 0.00004 as an upper limit to the wave length. MM. Calmette and Lhuillier have made diffraction experiments with two slits, and have obtained bright and dark lines without expressing an opinion as to the wave length of the rays.

Another closely allied question is whether Röntgen rays consist, like ordinary light, of radiations whose wave lengths vary over a considerable range. Such differences of wave length give rise in the case of light to the phenomenon of color, and the corresponding phenomenon for Röntgen rays has been studied by Dr. F.-V. Dwelshauvers-Dery (Bulletin de l'Académie Royale de Belgique, No. 6) under the name of actinochroism. Observing that differences in the degree of exhaustion of a Crookes tube might be expected to give rise to differences of wave length in the emitted rays, and that the higher the vacuum the shorter would the wave-lengths probably be, Dr. Dwelshauvers-Dery has examined whether certain substances are more transparent for certain Röntgen rays than for others. For this purpose, their transparencies were compared by placing the substances in front of a fluorescent screen and observing their shadows side by side with that of a test-object consisting of laminæ of tinfoil, whose total thickness could be varied at pleasure. To obtain the necessary variation in the nature of the Röntgen rays, it was found sufficient to compare the radiations from a new tube, which had not been previously used, with those emanating after the tube had been in action for some time. The observations were repeated on the new tube after a quarter of an hour, half an hour, an hour, an hour and a half, and two hours, respectively, and transparency curves obtained by plotting the results on paper. These curves show that (1) the transparency of every specimen, with the exception of obsidian, increases during the first few minutes; (2) agate and alum, after increasing in transparency for some time, become more and more opaque; (3) obsidian continually diminishes in transparency. It is, of course, here a question of relative transparency with respect to tin. Although we have no measure of the variations of the absolute transparency of the tin itself, the experiments suffice to prove that the absolute transparencies of different substances vary according to the state of the tube, and it is therefore, not considered hazardous to explain these variations by the actinochroism of Röntgen rays.

The same phenomenon has been observed by MM. Benoist and Hurmuzescu, and, perhaps, by other physicists. In some of Mr. A. A. C. Swinton's experiments it will be remembered that the properties of Röntgen rays, and particularly their power of penetrating through organic tissues, varied with the degree of exhaustion of the vacuum.

TELEPHONY AND TELEGRAPHY.

TELEPHONE LINE CONSTRUCTION IN THE ROCKIES.

Telephone construction in the Rocky Mountains is attended with a great deal of hardship. The line built from Leadville to Aspen several years ago is a case in point. It took two months, says the Denver "Field and Farm," to cover the entire length, forty-eight miles. In ordinary construction the poles would be set forty-two to the mile, but at certain points where sharp turns are necessary, the number sometimes increased to seventy-five to the mile. The members of the construction gang had to be expert as axmen as well as linemen, for when timber was encountered a path of 200 feet on each side of the line had to be cleared in order that wires might not be broken when trees were blown over by the terrific blasts which at times prevail in that region.

A great deal of the comparative slowness of the installation was owing to the inability of the workmen to labor in such a rarified atmosphere. At one point the wires were strung at an elevation of 12,000 feet above the level of the sea. In such an altitude the linemen soon became completely tired; after he has climbed two or three poles he has to take a rest to recuperate his energies. The preparation of the holes for poles, which would have been tedious in similar ground even in an ordinary atmosphere, was an especially slow and fatiguing operation. It was often necessary to blast a hole for the pole by the use of giant powder, and an ex-miner who had had an extensive experience with explosives, was assigned to the job.

The digging of one pole hole would sometimes occupy him a whole day, working honestly. Over 300 pounds of powder was used on the line for this purpose. When the continental divide was reached the poles had to be abandoned, and the wires placed in a cable, which was buried in a two-foot trench for a distance of 7,000 feet. The advisability of abandoning aerial construction at this point was demonstrated by the experience of the company that maintains the Leadville and Denver line. At one point on that line, Mosquito Pass, the poles were originally set seventy feet apart. As soon as the wires were covered with sleet they snapped and the line was useless. Double the number of poles were then used, with the same result. The space between the poles was then reduced to twenty-five feet, but when the sleet came the line was swept down flat. Eventually an underground cable was laid for two and a half miles, and there has been no trouble since.

DO TELEPHONE SUBSCRIBERS SWEAR?

The following statement of the influence of the telephone on the average subscriber is from the New York "Press." We venture to regard it as grossly exaggerated and untrue:

"The telephone system, as manipulated by the American Bell Telephone Company, is not only an insolent monopoly, but is the greatest uncivilizer of the age. The average man who goes to the transmitter to call up a friend, or for business, becomes a savage. The service in this city is so poor that he is in danger of becoming a devil. If bad language felt as hot as it sounds our telephone subscribers would have a sure revenge against the company, inasmuch as a few well chosen words would suffice to fuse the wires and wreck the plant. But, unfortunately, profanity hurts only the air, which, we have heard, it makes blue.

"Aside from the usual ordinary inducements to swear, which every man encounters in the course of the day—and the women swear a little, too, with their 'plague-take-its,' 'confound-its,' 'oh, bothers,' 'darn-its,' and similar fearful oaths—he is positively encouraged by the managers of the insolent telephone monopoly to let loose the vials of imprecation no less than ten times every twelve hours. A really good man dislikes to swear, and when he catches himself at it he is ashamed. His self-respect is lowered. A brave man who swears feels that the act has weakened his courage. But there is no escape from swearing at the "phone' as operated in this city. It is heathenizing us all.

"We find that there is an infinitesimal amount of swearing at the telegraph, the express, the theatres, the electric lights, the steam railroads, the ocean steamships, the ice trusts, the match trusts, the soda fountains, the bicycles and the type-

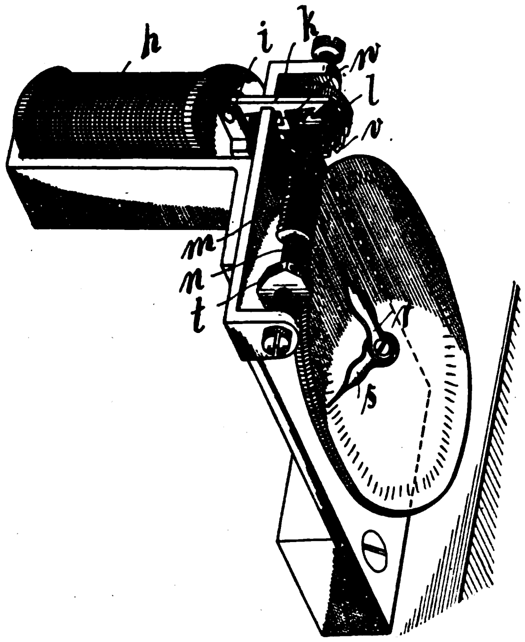
writers, but that nearly all of our profanity is expended upon the telephone, the cable cars and the gas monopoly. And of these three, telephone, cable car and gas, the worst of all is the telephone!"

MUNCH'S TELEPHONIC REGISTER.

A DEVICE for registering the number of times telephonic apparatus is used for conversation, and, if desired, the duration of such conversations, has been invented by August Münch, of Charlottenburg, Germany. For the registration of both the number and duration of telephone conversations, it is essential in any apparatus to be satisfactory that it should be easily and cheaply applicable to the arrangements already in use.

The operation of the registering mechanism is effected by means of single-current impulses which excite an electromagnet which serves to move the registering mechanism. This electromagnet is so connected with the switch mechanism of the central exchange that when the plug is used for the purpose of connecting or separating two subscribers' instruments, circuit closing devices are automatically brought together or separated by the action of the plug upon a spring. In this way the circuit of the electromagnet is either closed or opened so that it acts upon the registering mechanism.

This arrangement is applicable to single or to multiple



THE MUNCH TELEPHONE REGISTER.

switchboards of any system whatever, and possesses the advantage that the registering device may be set up at the central exchange and allows the usual switches to remain unaltered as far as the main details of their arrangements are concerned. It also has the advantage of not requiring a special manipulation of the attendants to operate the device.

When the switchboard plug is inserted or withdrawn, its head moves a projection by means of which an electric circuit from the local battery is closed through the electromagnet h (Fig. 1), of the registering device. The armature i of the magnet is thereby attracted and, by means of a pawl k, caused to operate a ratchet-wheel l, carried by an axle n, furnished with a worm m. This worm engages with two numbered discs p and q, which are able to rotate independently of each other on a stud o and one of which has, as in an ordinary Krafft's revolution-counter, one hundred teeth and the other one hundred and one teeth. In connection with these discs are two pointers, shown in the illustration, one of which, r, stands constantly at zero, while the other, s, turns with the disc, q, the extent to which the latter has turned, as compared with the disc, p, being thereby indicated. The ratchet-wheel l has twenty teeth, so that the armature must be operated twenty times to effect one complete rotation of the ratchet-wheel Two closures of the circuit are required for the registration of a conversation in correspondence with the working of the switchboard. A small numbered disc t on the axle n allows of numbering the units of conversations made. With the construction described this has ten numerals, one for every two teeth of the ratchet-wheel.

The mode of action of the apparatus is as follows: When a call is received from a subscriber, the attendant at the central station draws the corresponding plug out of the earth connection to see whether the desired circuit be free. As the plug is withdrawn two plates are pressed into contact with each other, so that the armature i of the electromagnet is attracted and the ratchet-wheel l is turned to the extent of one tooth and the worm-axle n through one-twentieth of a revolution. The small numbered disc will thus be moved half the distance it is to be moved for a conversation. If the attendant finds the desired circuit free, he will put the plug e in the corresponding aperture of the switchboard, and when the conversation is concluded he will replace the plug in the earth connection, whereupon the armature i will be again attracted and move the worm axle n another twentieth of a revolution, the two partial revolutions moving the registering-disc sufficiently to make the desired record. If the attendant finds the desired circuit engaged as will frequently happen in practice, he then places the plug not in the earth connection again, but in an independent aperture which may be either a dummy or provided with a contact-plate. The condition of the circuit may then be investigated by the attendant from time to time, and when it is finally found to be disengaged the connection is made. When the conversation is concluded, the plug is replaced in the earth connection and the registration by the counting mechanism is completed.

The attraction of the armature is more or less forcible according to the strength of the current in the local circuit, so that it is necessary to provide an arrangement by means of which the worm-axle n is prevented from turning through more than one-twentieth of a revolution for a single movement of the armature. For this purpose a crown-wheel v, with, say, twenty teeth, is placed upon the worm-axle n, and in the intervals between these teeth a catch w on the pawl engages at the moment when the ratchet-wheel l has turned to the extent of exactly one tooth, and thus locks the apparatus against movement until the magnet has been deënergized.

In order to effect the disengagement of the worm m from the indicating-discs, when it is desired to bring these to the zero-point, these discs are carried by a bent arm which rotates upon a pin, this arm being capable of being clamped in position by means of a screw.

If it is desired to record the duration of the conversations a train of clock work is inserted in the local circuit by which it is operated.

THE OPPOSITION TELEPHONE SYSTEM IN DETROIT.

THE Detroit Telephone Company's plant is rapidly approaching completion. Of the 60 miles of conduit that are to be laid 40 miles have already been laid, and the remaining 20 miles will be completed within a short time. Details of its work are given by the Detroit "Tribune." The company has contracted with the Standard Underground Cable Co. for the laying of cable, and shipments of cable to Detroit will begin in two weeks. The cable will all be laid within six weeks. The poles for telephone wire within the half mile circle have been purchased and are in the city and will all be set within three weeks.

The company has secured a 10 years' lease of the Jones building, corner of Griswold and Clifford streets, and will establish its exchange on the upper floor of that building, and begin the construction of the exchange switchboard as soon as the building is ready for occupancy, September 1. Then the work of putting in the 2,000 telephones within the two-mile circle will begin. It will be proceeded with very rapidly, and the company confidently expects to have 2,000 business telephones in operation by the middle of November. The company has nearly 5,000 telephone subscribers, of which number 3,500 have signed three-year contracts.

Of the 5,000 subscribers it is claimed the company has secured practically 80 per cent. of the Bell Telephone Company's subscribers, including almost every wholesale and retail grocer and druggist in the city, three-fourths of the physicians, and almost every business man on Woodward avenue, from the river to the Woodward avenue railroad crossing.

Up to date the company does not owe a cent, but has paid for all labor and material so far used in the construction of the plant. The company is authorized to issue $1,000,000 of stock. The original estimate for the completion of the plant is $600,000. So far in the work the actual cost has run a little below the estimates, and it is confidently stated that this will prove true throughout the entire work of constructing the plant. Of

the $1,000,000 capital stock authorized, $355,100 has actually been subscribed for, of which amount $300,000 has been issued, the remaining $50,000 having been sold to local subscribers on the installment plan, six months' time being allowed in which to pay for it.

Of the total amount of stock subscribed all but $25,000 is held by Detroit parties. There are very few stockholders who own more than $1,000 of stock, and the sum total of the stock held by these persons falls far short of representing a controlling interest in the company. The company can issue $1,000,000 of bonds, but at no time have the directors considered it necessary to issue more than $400,000 of bonds. It was originally proposed that these bonds be sold to stockholders, no individual stockholder being allowed to own more than $500 worth of bonds, but this idea has been abandoned. The company is using its bonds to some extent in paying for its work. The bonds are taken at par value rapidly, and are now being printed.

Stock enough has been sold to complete the plant within the two-mile circle, where the company has 2,000 subscribers. The conduit system of 60 miles will cost less than $225,000, and as soon as it is completed the company will extend it by running a conduit up the alley between Second and Cass avenues to Warren avenue. This is not required by the company's ordinance, but it is considered to be a stroke of economy in the long run on account of the great multiplicity of poles and wires already in the alley.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 25, 1896.

Alarms and Signals:—

SIGNAL APPARATUS. J. P. Coleman, Edgewood Park, Pa., 566,499. Filed May 21, 1896.

A fluid pressure cylinder for controlling the movements of a mechanically actuated signal.

AUTOMATIC SIGNALING. J. P. Culgan, Swissvale, Pa., 566,503. Filed March 18, 1896.

The arrangement of two banners in a case in such a manner as to be shiftable into and out of line with a common aperture and an arrangement of circuits operating magnets, whereby the banners are shifted into line with the aperture in the case or shell. It further provides for the successive control of a signal by two successive track-circuits.

ELECTRIC SWITCH AND SIGNAL APPARATUS. J. G. Schreuder, Wilkinsburg, Pa., 566,541. Filed March 31, 1893.

Method of operation and control of several parts of appliances of a railway switch and signal apparatus and the illumination of the signals by electric currents from a dynamo electric machine located at some central point or station.

ALARM FOR BOILERS. J. O'Connor and C. A. Turner, New York, 566,612. Filed March 20, 1896.

A float having connections at its highest and lowest positions with an electric alarm circuit.

Secondary Batteries:—

METHOD OF MAKING SECONDARY OR STORAGE BATTERY PLATES. W. Petschel, Berlin, Germany, 566,531. Filed Jan. 18, 1896.

Process consists in mixing or stirring together oxide of lead with sulphate of zinc in solution, so as to form a paste, then molding the paste, drying and then submitting to the action of dilute acid.

Conductors, Conduits and Insulators;—

INSULATOR SUPPORT. J. B. Oliver, Shields Station, Pa., 566,468. Filed Dec. 30, 1895.

Details of construction.

CONDUIT OUTLET INSULATOR. F. W. Erickson, Revere, Mass., 566,507. Filed June 8, 1896.

A hollow metallic pipe of the conduit, and an insulating member enveloping the outer and inner surfaces and the end or edge of the metallic member opposite to the end which is attached to the conduit pipe.

ELECTRIC CABLE CONDUCTOR AND SHEAVE WHEEL. J. F. Place, Montclair, N. J., 566,697. Filed April 12, 1894.

The combination of copper with other metal and insulating material, so arranged that the copper forms the outside and the other metal the core or inside of said conductor, with the insulating material as an annular ring between said copper and other metal.

Dynamos and Motors:—

RING ARMATURE. F. B. Badt and O. S. Lyford, Jr., Chicago, Ill., 566,288. Filed Jan. 15, 1896.

An armature provided with ventilating channels through its core.

BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES. C. E. Woods, Chicago, Ill., 566,366. Filed Jan. 15, 1896.

A frame having a series of brush-holding devices provided with a movable part adapted to engage the brush and a series of elastic connecting devices.

Lamps and Appurtenances:—

ARC LAMP HANGER. W. S. Bosley, Chicago, Ill., 566,652. Filed Feb. 13, 1896.

The lamp is suspended from a drum or roller, means being provided for rotating the drum to wind thereon or unwind therefrom the cords or cables from which the lamp is suspended. To the suspending cords is attached the cross-piece, which, when the lamp is raised, actuates a switch which throws the lamp into circuit.

Miscellaneous:—

SELF-WINDING ELECTRIC CLOCK. E. G. Hammer, Brooklyn, N. Y., 566,313. Filed Jan. 12, 1891.

The spring is wound at intervals by means of an electromagnet.

ELECTRIC HEATER.—H. O. Rockwell, St. Louis, Mo., 566,341. Filed Feb. 8, 1896.

A special frame within which the resistance wire is wound.

ELECTRIC DISPATCH SYSTEM. C. F. Pike, Philadelphia, Pa., 566,532. Filed May 31, 1895.

A tube having exhaust mechanism, a transmitter and receiver having end gates, one of which is controlled by a carrier exhausting mechanism and air supply for the receiver, electromotor for a carrier and a line conductor in the tube for the electromotor carriers.

ELECTRICAL HAMMERING MACHINE. T. C. Robinson, Boston, Mass., 566,537. Filed March 6, 1895.

A tack driving machine comprising a holder, a tack delivering throat, a driver movable in said throat, an electric motor within the casing to project and retract the driver and a motor controlling switch.

ELECTRIC HEATING APPARATUS. R. A. L. Snyder and A. F. Tinnerholm, Pittsburg, Pa., 566,545. Filed July 23, 1895.

An open magnetic core, a short-circuited secondary entirely surrounding the said core, a primary coil wound on the outside of the said short-circuited secondary.

ELECTRIC HEATING APPARATUS. M. W. Dewey, Syracuse, N. Y., 566,564. Filed July 24, 1891.

An electric heater covered with illuminated artificial fuel.

STEAM GAUGE. J. O'Connor and C. A. Turner, New York, 566,613. Filed March 20, 1896.

A steam gauge having a scale and an index arranged in the path of the index, an electric circuit, including said contact, and an electrically operated device controlled by the electric circuit when closed.

ELECTROLYTIC APPARATUS. O. W. Fielding, London, England, and L. B. Walker, Elizabeth, N. J., 566,673. Filed May 11, 1896.

The combination with anode and cathode plates, of separating and supporting blocks of insulating material having cords or flexible connections as a support.

ELECTRIC RHEOSTAT. H. W. Leonard, New York, 566,693. Filed May 10, 1895.

A method of preventing undue heating in an electric conductor, by placing the conductor in close proximity to a large mass of material having a high specific capacity for heating.

Railway Appliances:—

TROLLEY SUPPORT FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, O., 566,345. Filed April 20, 1896.

A laminated flat spring rigidly attached to the roof of the car, and which bends in the direction of the length of the car.

TROLLEY WIRE HANGER. W. Cooper, Schenectady, N. Y., 566,-376. Filed Sept. 28, 1895.

A wooden bar arranged above and substantially parallel with the trolley wire and supporting the trolley hanger proper and arranged to slide back and forth in a collar that is rigidly secured to a cross-arm above.

ELECTRIC RAILWAY CONDUIT. W. S. Hull, Dallas, Tex., 566,-397. Filed Feb. 28, 1896.

Contains a continuous metallic conductor, and a sectional metallic segmental conductor laid upon the upper interior walls of conduit and an inner, insulating tube held between the sections of the conduit and a hollow metallic spherical switch to travel bodily through the conduit in contact with segmental conductor.

ELECTRIC RAILWAY. C. Skinner, Chicago, Ill., 566,542. Filed March 7, 1895.

A sealed conduit placed alongside of and parallel to the track and circuit-closing devices for conducting the current from current wire to the car, the circuit-closing devices being operated by mechanical means that are actuated by the car.

BOND-CONNECTOR FOR RAILS. J. Bryan, Pittsburg, Pa., 566,-709. Filed May 21, 1896.

A connector which can be employed for attaching a continuous wire to the rail independent of the bond-wires at points intermediate of the rail ends or at the points at which the bond-wires are attached.

SWITCH FOR CONDUIT SYSTEMS OF ELECTRIC RAILWAYS. J. L. Hornig, St. Louis, Mo., 566,714. Filed Aug. 26, 1895.

Details of construction.

Regulations:—

SYSTEM OF CONTROL FOR ELECTRIC MOTORS. E. A. Sperry, Cleveland, O., 566,426. Filed Feb. 16, 1895.

Contacts for regulating the supply of energy to the motors and the brake magnets, contacts for weakening the field of one of the motors when they are used for braking the car, and the contacts for weakening the field of both motors when it is desirable to increase the speed of the car.

Switches, Cut-Out, etc:—

ELECTRICAL INDICATING AND CUT-OUT APPARATUS FOR PORTABLE OR OTHER ELECTRIC LAMPS. B. Hacking and G. Brand, Nottingham, England, 566,573. Filed Jan. 13, 1896.

A clockwork having a stop mechanism (which may be similar to that of an ordinary stop-watch) so connected with the switch of the electric lamp that the manipulation of the switch to light the lamp sets the clockwork in operation.

Telegraphy:—

FAC-SIMILE TELEGRAPHY. H. W. C. Cox and R. J. Crowley, London, England, 566,298. Filed June 19, 1895.

An ink which will permeate paper on which a message is written and which will by its permeation render the paper a conducting medium.

Telephones:—

APPARATUS FOR REGISTERING THE NUMBER OF TELEPHONIC CONVERSATIONS. A. Munch, Charlottenburg, Germany, 566,334. Filed Oct. 25, 1894.

For description see page 235.

TELEPHONIC APPARATUS. C. J. Schwarze, Adrian, Mich., 566,-416. Filed Feb. 11, 1896.

An instrument adapted to be used in connection with different telephone exchanges and which is made capable of being quickly changed from a magneto to a microphonic telephone, as required.

TELEPHONE EXCHANGE SYSTEM AND SWITCHING APPARATUS. A. R. Bennett, London; G. J. Somerville, Heaton Chapel, and R. McLean, Nottingham, England, 566,648. Filed March 20, 1896.

Enables the subscriber to a telephone exchange worked with metallic circuits to speak to the operator at will without any preliminary calling signal or the use of a special service or calling wire.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Miscellaneous:

CONDITION OF ELECTRICAL INDUSTRY IN BERLIN. —Reports of the firms Siemens & Halske, Allgem. Electr. Ges., Berl. Maschinenbau A. G., furnished to the Board of Trade. All report progress and a healthy condition of the trade.—"Elektrotechn. Zeitschr.," Aug. 13, '96.

Electro-Physics:

POLARIZATION PHENOMENA IN AN ELECTROSTATIC FIELD.—By Dr. L. Lombardi. From the annual report of the physical society, Zurich. Repeating former experiments by Grätz and Fromm, author investigated under Prof. H. F. Weber various dielectric constants; he found for petroleum 2.03, for olive oil 3.11, for water at 15° C. 80.4.—"Elektrot. Zeitschr.," July 30, '96.

Measurements:

DETERMINATION OF DIELECTRIC CONSTANT.—By Dr. C. Henike. A description of the handling of a rotating double commutator (secohmmeter) to determine the dielectric constant and temperature coefficient of liquid insulators.—"Elektrotechn. Zeitschr.," July 30, '96.

Dynamos and Motors:

ROTARY CURRENT MOTORS WITH REDUCED SPEED.—By Hans Görges. Delivered before the Verband Deutscher Elektrotechn. Author explains that three-phase motors can run or be made to run at two different speeds; that at times a motor may be made to run ahead of synchronous speed and will then act as a generator, which action may be utilized as brakes in hoists or possibly in railway service.—"Elektrotechn. Zeitschr.," Aug. 13, '96.

ON THE MULTIPLICITY OF BRUSHES IN LARGE GENERATORS.—By Wm. Baxter, Jr. Author advocates the use of a single pair of brushes.—"Elec. World," Aug. 29, '96.

Mechanical:

ROPE DRIVING.—By Abram Combe. In "Notes on the introduction and development of rope driving," the author advocates low velocity. The following minimum diameters of pulleys for the various sizes of ropes are quoted:

1¼ inches diameter rope,	3 feet diameter pulley;	ratio 1 to	28.8
1½ " " "	4 " " "	" 1 "	32.
1¾ " " "	5 " " "	" 1 "	34.3
2 " " "	6 " " "	" 1 "	36.

Power transmitted by each of the foregoing sizes with 100 rev. per minute, made by the pulley:

Rope 1¼ inches diameter	on a 3 foot pulley,	5 I. H. P.
" 1½ " "	" " 4 " "	8 "
" 1¾ " "	" " 5 " "	11 "
" 2 " "	" " 6 " "	15 "

Lond. "Elec.," Aug. 14, '96.

Mining:

THOMMEN COLLIERY IN VASAS.—Careful estimates gave the following expenditure for installing a steam plant:

Engine with piping, pumps and installation	fl 8,150
Machinery for coal separation	1,080
Illumination of colliery with 35 lamps (separate engine and dynamo)	1,600
	fl 11,200
	$4,032

For electric plant:—

Two dynamos with triple pump, including wiring and piping	fl 4,800
Electrically driven coal separator and lighting	2,400
Steam engine	1,300
	fl 8,500
	$3,060

The later was installed and is described in detail with illustrations in "Elektrotechn. Echo.," Aug. 8, '96.

Electro-Chemistry:

FLUORESCENT SUBSTANCES.—By A. Schertel. A short prescription for preparing platino cyanides.—"Journ. of Franklin Inst.," Aug., '96.

DESCRIPTION OF THE ALUMINA FACTORY AT LARNE HARBOUR.—By James Sutherland. Read before the Instit. of Mech. Eng'rs. After stating the sources of Al. author explains the K. H. Bayer process of manufacture from bauxite.—Lond. "Elec. Engr.," Aug. 14, '96.

Isolated Plants:

THE SYNDICATE BUILDING.—Light and elevator service are on the same 110-volt circuit. Three 200 horse-power engines and 100 kilowatt internal pole dynamos. Building is wired for 1,750 lights, taking 35,800 feet of wire. Details in "Elec. World," Aug. 29, '96.

Railways:

HOW TO SAVE MONEY ON FEEDERS.—By J. E. Woodbridge. An arrangement of rotary transformers is illustrated diagrammatically and described.—"Elec. World," Aug. 29, '96.

ELECTRIC RAILWAY UP MONT SALEVE, GENEVA.—Well illustrated description of this mountain road.—"Elec. Engr.," Aug. 26, '96.

PRINGLE AND KENT'S SURFACE ROAD.—A line with insulated studs with a distributor which supplies twenty-four surface contacts in succession, thus doing away with a great many electromagnetic switches. Summary of cost adapting this system to an existing tram line.

Cost per mile of single track, with distributors arranged to supply cars running in either direction; distributors and brick boxes	£ 301.	11.	0
Main conductor, 1 square inch section	755.	...	..
Iron conduit, excavating, concreting, etc.	1,228.	19.	..
Total per mile	£2,292.	10.	0
Cost per mile of double track	£4,130	0.	0

Lond. "Lightning," Aug. 13, '96.

Roentgen Rays:

AN X-RAY LABORATORY IN CHICAGO FOR MEDICAL DIAGNOSIS.—Dr. O. L. Schmidt and Dr. F. C. Harnisch have just opened this laboratory, the installation of which is illustrated and described in "Western Elec.," Aug. 29, '96.

Central Stations:

LIGHTING AND TRACTION FOR PLYMOUTH.—Mr. John H. Rider, M. I. E. E., handed in his report upon this plant, advocating the combination of light and railway service. The initial installation is to include three Lancashire boilers, with mechanical stokers and coal-conveying plant; two direct coupled steam alternators of 200 kilowatt each; two 100 kilowatt sets, each consisting of a vertical high-speed engine, with an alternator and a dynamo; rectifiers, or rotatory transformers, for the arc lighting; a battery of accumulators; and the requisite switchboards, condensers, pumps, etc. Electric motors will take the place of small engines for driving all the subsidiary machinery in the works. The estimates of total cost of installation is £46,000.—Lond. "Lightning," Aug. 13, '96.

Power Transmission:

ELECTRICITY AND MOTOR POWER.—By Mark A. Replogle. With an article on the "Greatest of electric water power propositions, Niagara Falls," this series of articles is brought to a close.—"Elec. Rev.," Aug. 26, '96.

Alternating Currents:

NOTES ON POLYPHASE CURRENTS.—By E. Gerard and G. Henrard. Data on European practice, from "L'Eclairage Electrique," in "Elec. Rev.," Aug. 26, '96.

NEW YORK NOTES.

THE ELECTRICAL MAINTENANCE COMPANY, 50 Broadway, is now almost two years in business and can count on its books about 300 electric plants in New York City and Brooklyn, comprising 952 machines of about 49 different makes. They have also 100 plants in Philadelphia, 25 in Baltimore and 33 in New York State. This company is similar to an insurance company, employing expert electricians to test the electrical machinery and appliances in plants, keeping them in order, assuming necessary expenditures to remedy defects, etc., etc., and making a reasonable charge for its services rendered.

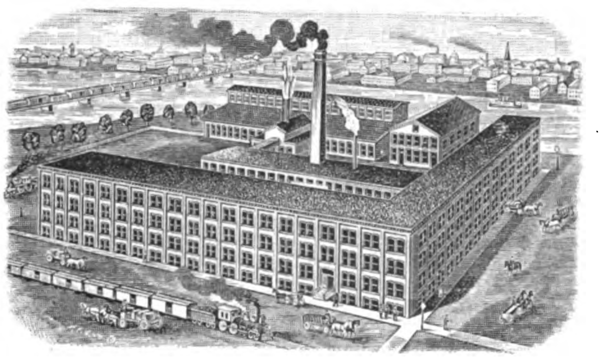
THE ELECTRIC APPLIANCE COMPANY report that their success with Armorite iron armored interior conduit is away ahead of their expectations, and their sales have already been very large.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

BARNES' METAL WORKING MACHINERY.

WE illustrate herewith the factory of the W. F. and John Barnes Company, located at 281 Ruby street, Rockford, Ill. This company, who manufacture a variety of high-grade machinery for metal working, both for foot and steam power, call special attention to their No. 4½ lathe which is the smallest back-geared and screw cutting lathe they make. This machine feeds right or left and cuts screws right or left with-



W. F. & JOHN BARNES FACTORY.

out change of gearing. The carriage is thoroughly gibbed for taking up wear. A general view of the machine is given in Fig. 2. These lathes are not made with an automatic cross feed. Twenty-five years' experience as lathe users and builders has convinced the company that on a small lathe, say, less than 15 or 16 inches swing, automatic cross feed is of no particular advantage. The tool carriage on these lathes swivels so that the tool can be set to work at any desired angle, and it also adapts the lathe for taper boring. These features, they believe, are of greater value than automatic cross feed.

The tail stock has side movement to adjust the centers for turning tapers. The head stock has hollow spindle for rods up

BARNES' NO. 4½ LATHE.

to ⅝ inch. All the gearing is cut from solid metal and all parts are made of steel where this best serves the purpose.

It will cut all ordinary threads from 5 to 48, and miscellaneous threads up to 154. It swings 9 inches, and takes 25 inches between centers. It swings 4¾ inches over tool carriage.

The company publish a catalogue which they will be pleased to forward to all interested users of high-grade metal working machinery.

CLEVELAND, O.—The Bradley Electric Light, Heat and Power Company, of Cleveland, has been formed by G. Lillis, J. C. Burgess, S. H. Holding, M. W. Neal and F .S. Mather with a capital stock of $100,000.

HUEBEL & MANGER'S NEW CATALOGUE OF ELECTRICAL GOODS.

THE enterprising and progressive firm of Huebel & Manger, 278-282 Graham street, Brooklyn, have just issued a neat and complete new catalogue of their electrical and brass goods. They give special attention, as is well known, to bells and push buttons, and this, their third catalogue, displays a very handsome and comprehensive assortment of such wares. Their bells have pure platinum in the contacts, riveted and not soldered, in the spring and screw, and are distinguished also by having their improved lock nut and immovable binding and contact posts. The gongs are nickel plated brass, of clear, sharp tone. These goods in all the classes of iron box, wooden box, and iron frame are excellent, and the prices are fair and moderate. A page is devoted to showing the different styles of gongs that are usually fitted on their bells, and the fact is mentioned that they also furnish a 2½ inch wooden gong.

The push button goods are also shown in a great variety of styles, all being made with hard rubber centers and German silver springs, and with washers under the contact screws. They also have hard fiber backs. The sizes are like the shapes, numerous and suited to all standard work in the house, office, etc. The specialty in improved water-tight push buttons brought out in 1895 is admirably adapted to use in cold storage warehouses and other damp places. It is made with a protecting inner cap, while the connecting wires also run in through insulating tubes.

Among other goods made by the firm and illustrated or mentioned in their catalogue are gas key pushes, watchman's key switch, table pushes and connections, midget pushes, rubbing contacts, bronze letters, wood and rubber switches, window attachments, mouthpieces, letter boxes, binding posts, etc. There is also a very ingenious line of brass novelties in the shape of cigar rests and ash receivers, combination pincushion and spool holders, etc., to be clamped readily on chair or table, and for which a large market must exist everywhere. The firm will be glad to send a copy of this catalogue to any address.

CLAY AND PORCELAIN GOODS.

The Akron Smoking Pipe Company, of Mogadore, O., are extensively engaged in the manufacture of all kinds of white and brown clay and porcelain insulators, being a new department which this company have added to their business. They make insulators in a variety of sizes running from one to twenty-four inches, with diameter from 5-16 to 1¾ inches. They also manufacture in the three materials two styles of cleats which are designed to hold two wires, a complete line of knobs suitable for all wiring purposes, such as telephone, telegraph, street railway purposes, etc., and a line of specialties. They solicit any specialty that is used in quantities that can be manufactured either of porcelain or clay material, such as fuse boxes, switchboard plates, etc.

RACINE ENGINES.

The Racine Hardware Company, of Racine, Wis., are building a general purpose engine, but it is specially adapted for electric lighting or other purposes requiring uniform power, close regulation and extreme economy.

They build high grade automatic cut-off engines in the small sizes, the vertical from 1 to 55 horse-power and horizontal from 30 to 55 horse-power inclusive. These engines have been on the market for the past ten years, and have gained a reputation for service, durability, economy and general efficiency. They embody the highest quality of mechanical construction throughout, and contain the best material.

All "Racine" engines are furnished with a broad outer bearing, giving three bearings to the shaft for belt connection and four bearings for direct dynamo connection. They are furnished with a sub-base and do not require an expensive foundation. All wearing parts are made adjustable to wear. Seventy per cent. of the company's engine sales are for electrical purposes.

CENTRAL ELECTRIC 100-HOUR ARC.

The Central Electric Company, 173-175 Adams street, are introducing a new 100-hour arc lamp for use on 110-volt direct current circuits. The lamp is used singly instead of the usual "two-in-series" fashion and gives a brilliant yet soft and steady light without hissing or noise of any kind. The Central Electric Company also reports a very encouraging prospect for fall business. Even during the dull season orders for such standard goods as Wagner transformers, okonite wire, and interior conduit, have continued without apparent diminution. Large orders have been recently placed for brass and iron armored conduit. The season for fan motors just

closing has been a very successful one. The Lundell seems to gain popularity as the seasons go by. The Central Electric Co. have sold several hundred more this year than last.

J. H. BUNNELL & CO.

The old and ever enterprising firm of J. H. Bunnell & Co., 76 Cortlandt street, New York City, have stolen a march on Father Time by issuing in August their catalogue, No. 15, dated October, thus eclipsing the magazines which usually appear half a month before they are due. It is an unusual thing, indeed, to see a catalogue ahead of time; in fact we have known of catalogues that were belated a whole year; but in the present case the promptitude shown is but another evidence of the intention of the firm of J. H. Bunnell & Co. to be up and doing, no matter how hot the summer or how unsettled the political aspect. In fact, there are many lines of electrical goods that are just as necessary, in the dullest times, as bread, beef and whisky, and such electrical goods, the firm propose to supply, once they can get within touch of a prospective customer.

The catalogue runs a length of 224 profusely illustrated pages (800 cuts, many of them new), and the cover bears a neat reproduction of one of the diplomas awarded the house at the World's Fair. The goods brought under notice range through all the branches of the art, from telegraphy to X-ray apparatus, and embrace whatever is standard and up to date. The selection of tools and implements is also complete and excellent in every way.

Accompanying the catalogue, the firm have sent out, and will supply to any address on application, a copy of S. M. Wells' "Electropathic Guide," a book intended to go with the J. H. Bunnell & Co.'s No. 4 D. D. Medical Battery. This little book contains a great amount of well digested data on the subject of diseases to which electrical treatment is applied.

CHLORIDE CELLS FOR "ELLERSLIE."

The Electric Storage Battery Company has closed a contract through W. T. Hiscox & Co., for a storage battery installation for "Ellerslie," the residence of Governor Morton, at Rhinecliff, N. Y.

The battery, which will be located in the power house, 1,400 feet away from the mansion, will consist of 67 chloride accumulator elements, type G-11, in lead-lined wooden tanks. The generator will be run but a few hours per day, and the battery will carry the lighting load during the time that the dynamo is shut down and over Sunday, thus giving a 24-hour lighting service per day with but a comparatively very few hours' run of the generator.

BIG BUSINESS OF THE WALKER CO.

AMONG recent orders received by the Walker Company may be mentioned incandescent lighting machines, as follows: One 100 kilowatt and one 30 kilowatt direct connected, multipolar generators for Murray Hill Hotel, New York City, and switchboard complete; Two 75 kilowatt, direct-connected, multipolar generators for Windsor Hotel, New York City; one 50 kilowatt, direct-connected multipolar generator and switchboard for Cochin, China.

Railway generators as follows: Six 600 kilowatt, special rope driven multipolar generators and switchboard for Chicago City Railway Company; four 200 kilowatt, direct-connected multipolar generators for Englewood and Chicago Railroad (storage battery road); one 400 kilowatt, direct-connected multipolar generator for London, Ont., Street Railway Company; one 300 kilowatt, direct-connected multipolar generator for Pacific Power Company, of San Francisco, Cal.; two 150 kilowatt, direct-connected multipolar generators and switchboard for Albion Construction Company, Chicago, Ill.; one 1,200 kilowatt, direct-connected multipolar generator for Metropolitan Street Railway Company, of Kansas City, Mo.; two 400 kilowatt, direct-connected multipolar generators and switchboard for Brooklyn Bridge; one 600 kilowatt, direct-connected multipolar generator and switchboard for Albany Railway, Albany, N. Y.; two 600 kilowatt, direct-connected multipolar generators and switchboard for Syracuse Street Railway Company, Syracuse, N. Y.; two 100 kilowatt belted generators for Hamburg, Germany; two 250 kilowatt, direct-connected multipolar generators and switchboard for Newcastle Electric Company, Newcastle, Pa.

Among recent orders for equipments may be mentioned: Twelve double No. 3 narrow gauge motor equipments for Hamburg, Germany; forty No. 3 double motor equipments for Brooklyn Heights Railway Company, Brooklyn, N. Y.; twenty-three No. 10 special storage battery equipments for Englewood and Chicago Electric Railway, of Chicago, Ill.; four double No. 10 motor equipments to Union Railway Company, of New York City; five double No. 10 motor equipments for Albany Construction Company, of Chicago, Ill.; one double No. 3 motor equipment for Meridian Street Railway Company, of Meridian, Miss.; one double No. 3 motor equipment for Market Street Line, San Francisco, Cal.; eleven double No. 15 motor equipments for Rapid Railway Company, Detroit, Mich.; eight 50 horse-power equipments for Union Railway, New York City.

Among recent shipments may be mentioned: one 100 kilowatt, direct-connected multipolar generator to Rapid Railway Company, Detroit, Mich.; two 750 kilowatt, direct-connected multipolar generators to Detroit Railway, of Detroit, Mich.; one 600 kilowatt, direct-connected multipolar generator for Los Angeles Street Railway Company, of Los Angeles, Cal.; one 25 kilowatt, direct-connected, 220 volt, multipolar generator for Abner-Doble Company, of San Francisco, Cal.; one 50 kilowatt, direct-connected incandescent lighting machine for Jordan Marsh & Co., of Boston, Mass.; three 25 kilowatt, direct-connected incandescent lighting machines for Mohawk building, Cleveland, O.; five double No. 3 motor equipments to Hamburg, Germany; five double No. 3 narrow gauge equipments to Paris, France; five double No. 4 motor equipments to Rahway, N. J., and numerous other orders for equipments.

NEW ELECTRIC CARRIAGE OF THE AMERICAN ELECTRIC VEHICLE CO.

ON Tuesday, August 25, several representatives of the trade and technical press had a very enjoyable ride in the new electric brake which has just been constructed by the American Electric Vehicle Company, of Chicago, for the well-known firm of Montgomery Ward & Co. This concern have an immense business all through the country, which is entirely transacted through the mails, as they don't employ any traveling salesmen. It is their intention that the brake shall be sent all over the States. Stops will be made in the principal towns, and the carriage driven through the streets. A Pullman car has been purchased by the company, which they have had elegantly fitted with sleeping and living accommodations for the use of those who will have charge of the brake. In the middle of the car a place has been constructed which will be occupied by the brake during the journeys between the different points.

The brake, which is an elegant specimen of the carriage builders' art, is equipped with two 2 horse-power single reduction motors which can be worked up to about double their nominal capacity when necessary. Instead of the sprocket and chain gear which has been so generally used on horseless carriages, the two motors are geared direct to the rear wheels of the vehicle by two small rawhide pinions on the motor shafts, meshing into large brass pinions attached to the axle inside the wheels.

Attached to each of the motors are also two geared wheels for the purpose of changing the speed of the motor shaft when necessary, this unique piece of mechanism being regulated from the driver's seat. The carriage is also equipped with controller, brake and steering apparatus, and for night runs two incandescent lamps are used which are enclosed in handsome lamp holders of the regular type used in carriages. The carriage is very light in appearance, contains two seats capable of holding six persons, and will be able to run up to a speed of 14 miles an hour. The motors and controllers are of a special pattern made by the American Electric Vehicle Company, the storage batteries being of the well-known make of the Syracuse Electric Battery Company, Syracuse, N. Y.

CLAIMS IN FAVOR OF ENCLOSED ARCS.

The "Pioneer" enclosed arc lamp, manufactured by the Electric Arc Light Company, 687 and 689 Broadway, demonstrates that it is possible to obtain an absolutely steady arc without casting any shadows on the globe. Before the advent of the enclosed arc, it was common to see arc lamps sputtering and burning irregularly, and globes being cloudy with shadows. Even with the best open arc lamps of the present time the presence of shadows is noted on the globes. When the method of operation of these lamps is taken into consideration the explanation of this disagreeable feature is simple. In the open lamp the arc is very short, being generally less than an eighth of an inch in length. When the lamp is in operation the light from the arc is largely obscured by the carbon points, the latter casting shadows on the globe.

With the enclosed arc operated by the Marks method the distance between the carbon points is about four times as great as in the case of the open arc, and the light is not obscured. Besides this the carbons are very small in diameter, thus increasing the efficiency of the arc and giving the largest percentage of available light. Moreover the small enclosing bulb

which is used in the "Pioneer" lamp acts as a diffusing medium and distributes the light perfectly. It is safe to say that over 25 per cent. of the light which is lost in the open arc is made use of in the "Pioneer" enclosed arc.

CHANGES IN THE CUTTER CO.'S BUSINESS.

The Cutter Electrical and Manufacturing Company, of Philadelphia, report that they have closed out their entire construction and repair business to Messrs. Francis Bros. & Jellett, of that city. This step has been taken by reason of the large increase in their manufacturing business. In future the Cutter Electrical and Manufacturing Company, will devote their entire attention to the manufacture of their two specialties, the C-S flush switch and the I-T-E circuit breaker. Notwithstanding the dull season the Cutter Electrical and Manufacturing Company report that their sales during the previous two months have far exceeded the business done in any other two months. This is largely due to the success which has attended their efforts to introduce their I-T-E circuit breaker.

The Electrical Exhibition held in May last in this city gave them an unusually good opportunity to bring their needed device before the public, which was just about ripe for such an improvement. Making an attractive display, and having a thoroughly reliable article, the need for which was daily growing stronger, it was natural to expect largely increased business, but the actual business done has far exceeded their expectations.

They have closed contracts for their circuit breakers well known by the name "I-T-E," with some of the most exacting electrical concerns in the United States. These orders were not placed until the circuit breakers were subjected to every known test, and it was clearly demonstrated that their device would do all and more than was claimed for it. The edition of their I-T-E circuit breaker catalogue which was published last spring, has been almost exhausted, and they are about to go to press with another edition, containing all their improvements to date.

NEW PLANT FOR THE EMERSON MFG. CO.

The Emerson Electric Manufacturing Company, of St. Louis, after five years in their present location, have found that they need increased facilities and quarters better adapted to their growing business, and have secured a new location at Eighth and St. Charles streets, in the very center of the wholesale and manufacturing district, where their several departments of manufacturing will be on one floor, and in exceptionally large, roomy and well lighted quarters. They have arranged to keep their business moving with little delay, and assure their customers that orders will have as prompt attention while the change is being made, as heretofore. In spite of dull times, this enterprising firm have secured a large increase of business for 1896, over the year of 1895, and with increased facilities in their new location, are prepared to make a new record for the future.

THE DALE COMPANY.

Our readers will be interested to learn that the former Dale Manufacturing Company has ceased to exist and that it has been succeeded by the Dale Company, a corporation formed under the laws of the State of New York. Mr. John H. Dale is the president of the new company, and will have personal charge of the manufacture and sale of its product. As heretofore, the company will devote its energies to electric light specialties, combination fixtures, etc., but new facilities are being added, and the delivery of goods will be expedited. All orders will be filled according to the numbers in the existing Dale catalogues, copies of which will be sent to any address upon request; and the old rates of discount still apply.

The company's agents are: Kennedy & Du Perow, Washington; Pettingell-Andrews Co., Boston; Standard Electrical Works, Cincinnati; Michigan Electric Company, Detroit; Robbins Electric Company, Pittsburg; Commercial Electric Company, St. Louis; Western Electric Company, Chicago and New York. All mail matter should be addressed to the Dale Company, 108 Greenwich street, New York, and not to the Dale Manufacturing Company, which, as stated, is now out of existence.

NEW ENGLAND NOTES.

MR. GEORGE C. EWING, of Boston, agent for the Western Electric Company's electric railway apparatus, is also doing a successful business in second-hand apparatus of all kinds. He has at present a lot of railway apparatus, including cars, motors, controllers, etc., which he is offering at surprisingly low figures.

MR. CHAS. N. WOOD, of Boston, is enjoying a well-earned reputation as a reliable dealer in second-hand apparatus, and has on hand some bargains in electric railway appliances that are worth inquiring into.

THE WHEELER REFLECTOR COMPANY, of Boston, are calling the attention of the electrical trade to their immense variety of reflectors, of which they always have on hand a large stock for immediate delivery. This company are the pioneer in this line of goods, and as the shortening days and earlier nights approach, they are enjoying a good business, in furnishing progressive users of incandescent light with suitable reflectors, which undoubtedly enhance its value and at the same time produces effects otherwise unattainable. Rather pleasant reflections in these dry days!

BRATTLEBORO, MASS.—A Cushing switchboard for operating the electric lights in the opera house has been placed in the auditorium. The board is equipped with 38 switches, which control the lights in all parts of the stage and audience-room, and four dimmers for varrying the intensity of the light, whereby any combination of colors may be made, producing sunlight and moonlight effects, etc. The board is also equipped with two large switches which control all the lights in the house. The stage is furnished with 120 24-candle-power white lights, 124 red and 124 green lights of the same candle-power.

NEW YORK NOTES.

THE METROPOLITAN TELEPHONE COMPANY has transferred its property and buildings in this city to the New York Telephone Company, which takes its place.

MR. FRANK SUTTON, E. E., a former graduate of Columbia University, has opened an office as electrical engineer at 27 Thames street. He is prepared to do general consulting work.

THE STAR ELECTRIC LAMP COMPANY, of Tarvers, N. Y., has been formed with a capital stock of $50,000. The directors are: J. Silver, of New York City; R. R. Moffatt, of Brooklyn, and G. W. Mills, of Elizabeth, N. J.

THE DALE COMPANY, of New York City, has been formed to make electrical chandeliers and other electrical supplies. The directors are W. E. Hawkins, J. H. Dale and D. Dale, all of New York City. The capital stock is $25,000.

FIRE IN THE "BIG STORE."—A fire broke out last week among some painters' stores in the basement of Siegel, Cooper Co.'s new "Big Store," and an explosion resulted. The only person who was hurt was Mr. Harry Alexander, the electrician, who was burned on the hand by blazing oil. His dynamos were close to the place of danger, but he stuck to his post and gave valuable aid to the firemen by keeping the otherwise dark basement lighted. It will be remembered that Mr. Alexander has installed for the company a large plant, which his staff have lately been getting into full operation.

ADVERTISERS' HINTS.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

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MISCELLANEOUS.

THE TESTING DEPARTMENT OF THE GENERAL ELECTRIC COMPANY'S WORKS.—I.

BY THEO. STRAUS.

INTRODUCTORY.

THE General Electric Company, realizing the necessity and importance of thoroughly testing all apparatus before shipment, have, at an immense outlay, constructed at their Schenectady works a model building, to be used for testing and experimental purposes. This paper is intended to place before the public in a general manner, the striking degree to which this department has been developed in the last few years, and to give a description of this building, with its different modern appliances, resources and means for testing the various styles, forms and types of machines, now placed by the company on the market.

TESTING BUILDING NO.—XI.

The building, designated at the shops as No. 11, is substantially built mostly of brick, and steel, wood being used only where found to be an absolute necessity. It is two stories in height, having galleries on each side running lengthwise, and tapering at one end, giving an average length of 310 feet.

The sides being parallel, the width is 91 feet throughout its length. Its eastern extremity is connected with the old testing building, No. 12, by an overhead arch, covering the craneway, and at its western end by an annex to building No. 9, one of the large machine shops.

The second floor of this annex is used as a tool room and the first floor for storage material It is 60 feet in width, with an average length of 79 feet. The soil being very sandy, extra care was taken with the foundation. The piers upon which the building rests have a footing of stone 5 feet in depth, being 3 feet six inches square at the top and tapering to 4 feet 6 inches at the bottom. Below this for a depth of 2 feet is a foundation of concrete 7 feet square. Besides this, 36 of the 55 piers have granite caps 12 inches in thickness and 3 feet square, bedded on the top of the stone footing. The retaining walls, built upon these piers, which are 18 feet apart and connected together by an 18-inch foundation,, are of hard, well-burned brick, 16 inches in thickness, and rise to the height of 30 feet. The columns for the craneway and roof supports are of Z bar section, weighing respectively 58 and 39.8 lbs. per lineal foot. These have a riveted base, are set on the granite caps of the piers and are held together and secured to the craneway girder. The craneway girder, running lengthwise of the building is of steel plate 30 inches deep and weighing 152 lbs. per foot. Firmly clamped to the craneway girder is a 5-inch rail of steel weighing 95 lbs. per yard, upon which run the cranes. Twenty-one steel trusses resting upon the columns support the roof over the craneway space. The girders under the galleries and flat roof are imbedded in the wall and fastened to the columns. Extending from end to end of the building they are so constructed that small electric traveling cranes run on the lower flanges. The floor beams of the galleries, bolted at one end to the girders and resting on the retaining walls at the other, are of 12-inch I-beams, weighing 32 lbs. per foot, and are spaced four feet to centers. The rafters of the flat roof are of 9-inch I-beams weighing 21 lbs. per foot, and spaced 9 feet to centers. These project two feet over the retaining wall and are bolted to the longitudinal girders.

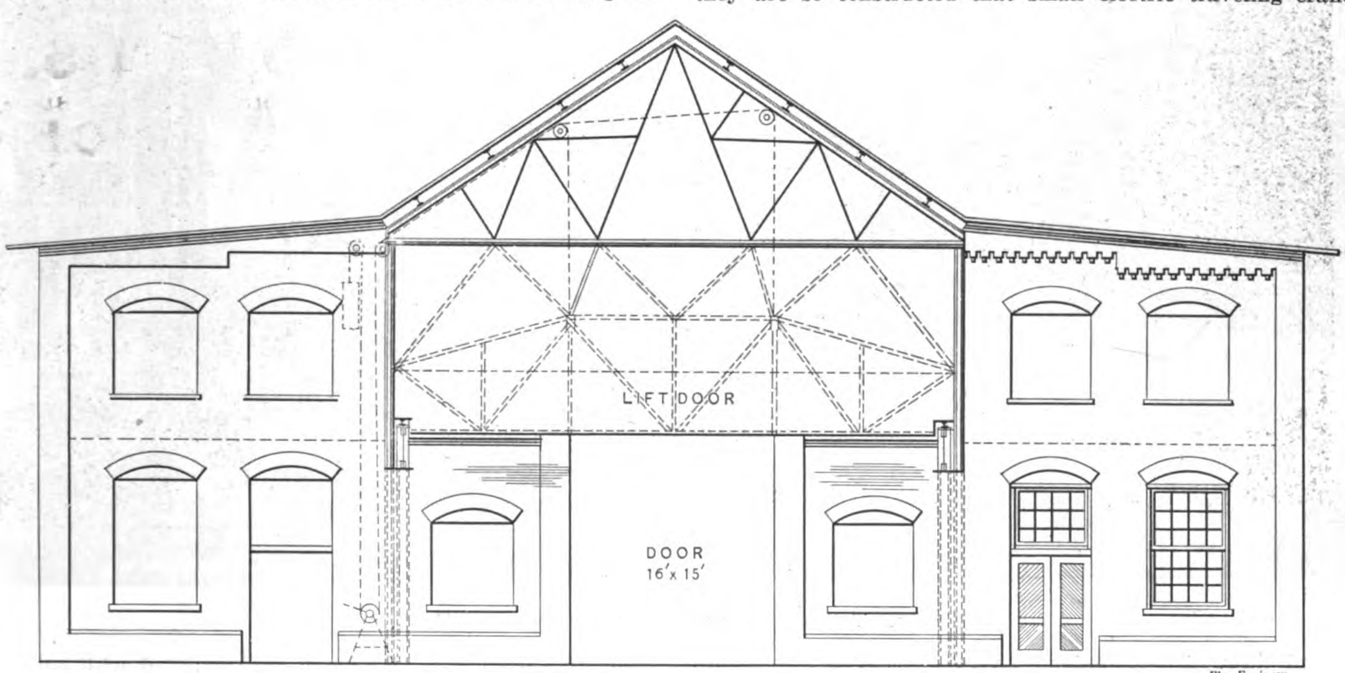


FIG. I.—NEW TESTING DEPARTMENT BUILDING, SCHENECTADY.

The flat roof over the galleries is covered with a preparation of gravel pitch and tar, and the inclined roof, over the craneway area by tin and translucent fabric for skylights. These lights are 16 feet wide on each slope, and run continuously from end to end of the building, being fastened to the purlins, which are bolted to the trusses. The effect of the light through these skylights and side windows upon the white painted interior, gives a clean appearance seldom seen in a factory building. Beneath the skylights is a copper wire screen of No. 14 gauge and of 2-inch mesh. On each side of the galleries are railings 42 inches high and of No. 10 iron. The foundation for the ground floor was prepared by laying a 5-inch layer of concrete, made of screened cinders and coal tar, both being

heated and mixed proportionally. On top of this was laid an under floor of best straight grained hemlock 2⅞ inches thick and 8 inches wide. The upper floor is of best 1⅛-inch square-edged maple, kiln-dried, and 4 inches wide. Throughout the building at different points, imbedded in the floor, are heavy iron bed plates, set in a foundation of grouting upon which the heavy machines are tested. At the western extremity is installed an Otis electric freight elevator run by a G. E. 800 railway motor. This, together with the electrical connections, was supplied by the General Electric Company. At the eastern end are lift doors which are raised and lowered as the cranes pass in going from one building to the other. These doors are of angle iron frames and are sheathed on one side with No. 16 iron. Located at both ends, are stairways connecting the galleries with the ground floor. The building is ventilated by seven 60-inch ventilators placed on the apex of the roof and distributed throughout the building. There are two traveling electric cranes built by the Morgan Engineering Co., one of 20 tons capacity and the other of 40 tons. In the center of the main floor running from end to end, connecting building No. 12 at one end, and No. 9 at the other, is an electric railway operated on the closed conduit system.

In the middle of the track, at equal intervals, are contact strips, which are switched in and out of circuit as the car passes over them, by the automatic operation of electromagnets.

At the northeastern corner of the building are located the consultation room and the office.

The consultation room is used exclusively for the engineers, who are in the building at various times throughout the day, keeping in touch with everything that is going on. The office is used by the manager of the department, his assistants, the office corps and the calculating department.

SYSTEM OF WIRING.

The testing department includes not only the work performed in the main testing building, No. 11, but all testing at the company's works. The department is subdivided, according to the character of the tests, into different sections, each section having a separate head, but under the direction of the manager. The sections located in the new building, No. 11, are:

Tests of small motors and generators below 25 kilowatts.
Tests of large motors and generators above 25 kilowatts.
The marine test.
The induction motor test.
The railway motor test.
The special and experimental testing.

With these different tests in one building it necessarily becomes very difficult to arrange the power, widely varied in character, so that the requirements of the different sections will not interfere with each other. To obviate this, considerable attention has been given to the system of wiring. Stationed throughout the building are switchboards known by letters numbering from A to H. These are connected with one another by cables either stretched overhead beneath the galleries or through terra-cotta tubing laid under the ground floor.

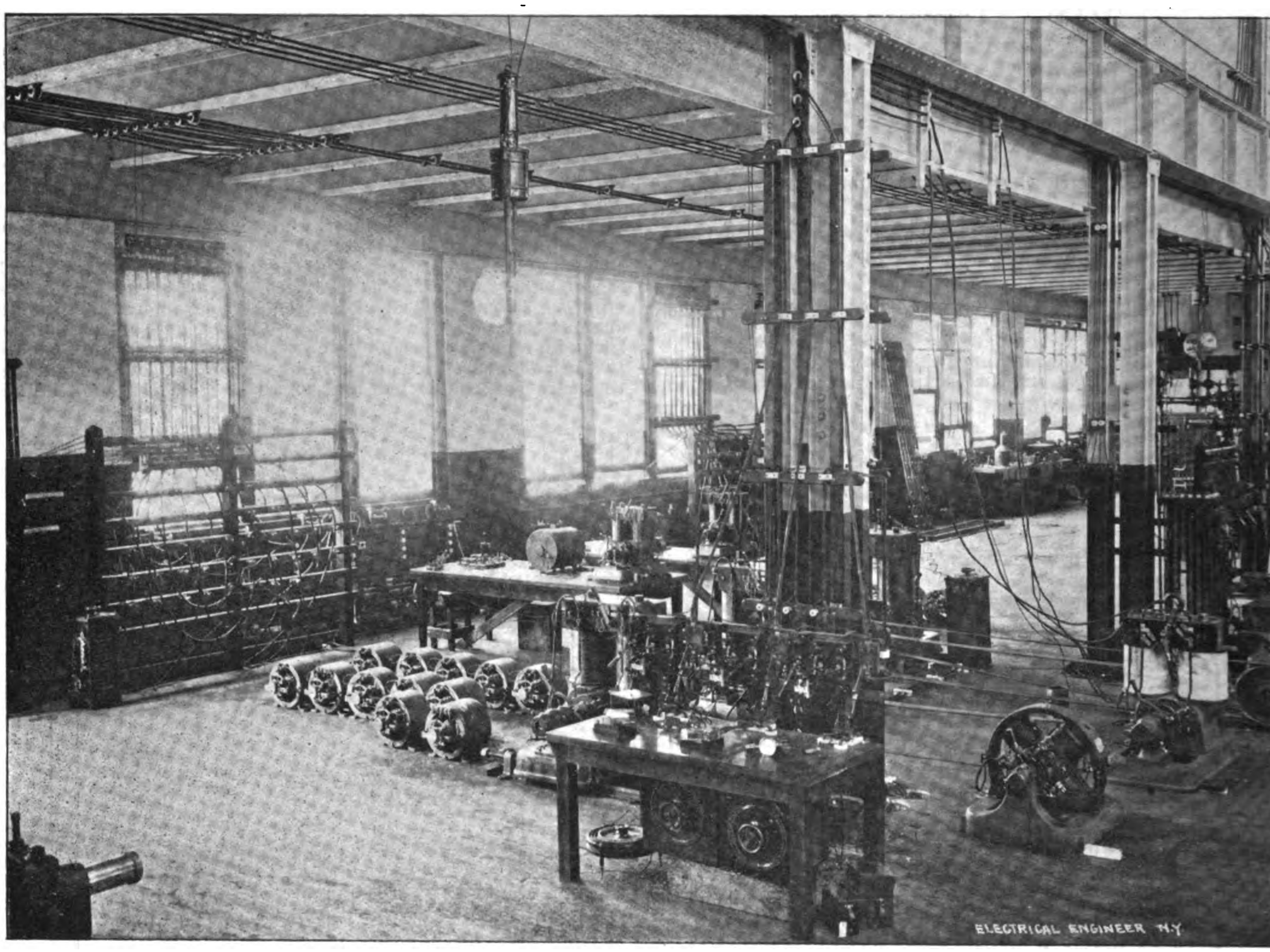


FIG. 2.—TESTING ROOM FOR MACHINES UNDER 25 K. W.

On the various columns are located switches and terminals which are connected to the nearest switchboard. On every switchboard, no matter where it is located, are currents of all voltages, either connected with machines running temporarily on the floor, or from the power plants, located in this building, and in building No. 12, or from the central power station. Therefore, in running a test, it is only necessary to connect short cables, to the nearest switchboard or column to obtain the current suitable for the occasion. This is strikingly noticeable, one rarely seeing any obstruction produced by the stretching of cables along the floor except at close proximity to the machines in test.

As an example of this arrangement, if one has occasion to connect a machine at one part of the building to a generator at another part, he would go to the nearest switchboard (say E) and connect his machine to cable building posts marked, say, 22D. Then going to switchboard D, he would find the terminals of the cables marked 22E. Connecting the generator to these, he would obtain the required power at the machine terminals.

Water rheostats are also connected to the switchboards. They consist mostly of box-shaped iron castings, resting upon porcelain insulators, and having a regulating plate, which can be moved in and out of the water according to the desired load. The others are of wood, with a permanent iron plate at one end, and another sliding plate, movable from end to end.

There is one point alone, above all, which shows the immensity of this department; that is the amount of copper wire and cables permanently placed throughout the building.

Besides using thousands of feet of cables from the old testing building, the following new rubber covered cable and wire was used in building No. 11: 7,000 feet of 500,000 cir. mils cable; 2,000 feet of 250,000 cir. mils cable; 2,000 feet of 200,000 cir. mils cable; 4,000 feet of 100,000 cir. mils cable; 8,000 feet of 26,250 cir. mils No. 6 B. & S. wire; 2,000 feet of 10,380 cir. mils No. 10 B. & S. wire. Approximately, about 10 miles of new and old wire and cables are in use.

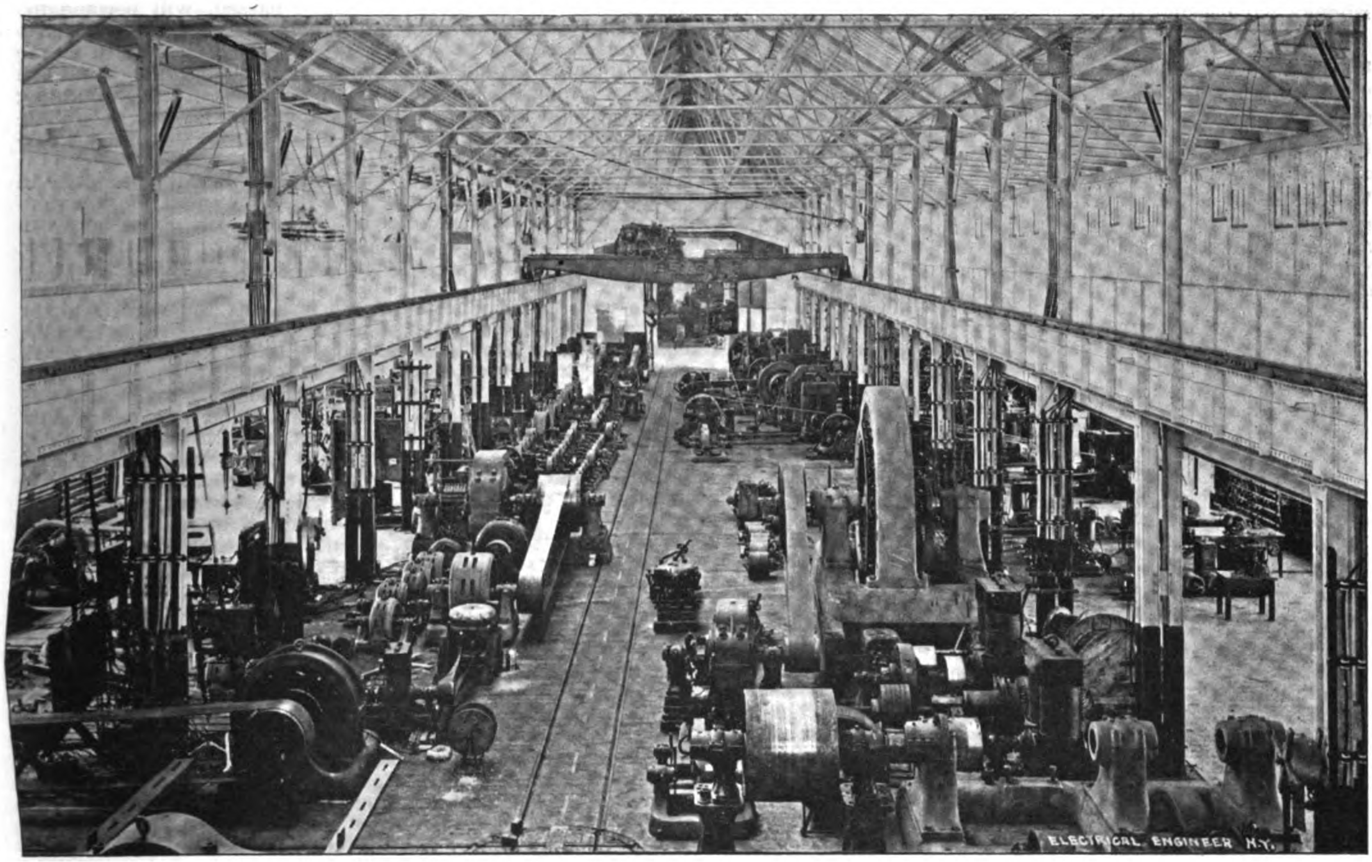


FIG. 3.—INTERIOR OF NEW TESTING BUILDING, SCHENECTADY.

A TIME TO CELEBRATE.

Many facts, recently presented to the public, make, when taken together, a splendid showing for Buffalo's continued growth. One of the most striking of these is the fact that their street railways in the fiscal year just ended carried 4,798,936 more passengers than in the preceding year. The assurance that power will be electrically brought to Buffalo from Niagara Falls by November 1st is being widely commented on by the press of the country.

It won't hurt Buffalo to have this thing talked about. She might talk about it herself to good purpose. And why not hold some sort of an electrical jubilation, as was proposed a year or so ago? It can be easily arranged so as to draw a great crowd, please the visitors and advertise the town.

And if held soon after the 3d of November it can be treated as a celebration over the industrial progress of the Niagara frontier, and a Thanksgiving jubilee over the election of McKinley.—Buffalo "Express."

AN EXAMPLE OF WHAT TO AVOID.

Whenever electric traction is under consideration by town councils or other local authorities the usual practice is to appoint a committee to visit the best existing electric lines in the country and report on them.

The London "Electrician" thinks that, by way of contrast, it would be a good thing to show these deputations how the work ought not to be done. A striking instance of this would be afforded by the electric Vevey-Montreux-Chillon tramway. The overhead construction of this ancient line is simply amazing. The two conductors consist of iron tubes about one inch in diameter, having an underrunning slot in which the collectors slide. These tubes are suspended from a bearer wire, and this again is carried by brackets fastened to houses or wooden posts. All the feeders are carried overhead, too; and in places where the line is double the mass of wires and iron work looks most formidable to the passer-by. But all this is as nothing compared with a ride over the line on a top seat. The line is about six miles long, with single track, which is now on one side and then on the other side of the road. The connecting cables between the sliding contacts and the car hang down anyhow, and when the overhead conductors run from one side of the road to the other, or when the line runs round a sharp curve, an outside passenger is in danger of being strangled. It would be well for peripatetic committees to see for themselves what an electric line may become without proper control.

AN UNLUCKY ELECTRIC MOTOR.

Lawyer Francis H. Van Vechten, of Jamaica, counsel for the Long Island Illuminating Company, will shortly begin an action against Queens County to recover a large sum of money, which, he alleges, is due his client on the contract signed January 17, 1895, under which it was to furnish electric power for operating a motor which was intended to turn the old Vernon avenue bridge over Newtown Creek for five years. A similar action is likely to be instituted against Kings County if the company's bills are not settled.

A motor which cost both counties $2,100 was furnished for the bridge. The first time the power was turned on, the structure was turned too rapidly, and all the cogs of the turntable were torn off. No sooner were the necessary repairs made than the British ship Eurydice ran into the bridge and damaged the motor beyond all hope of repair. That was nearly a year and a half ago, since which time the damaged motor has lain idle, and the two counties are paying about $450 a month to men who are employed to turn the structure by hand.

MR. W. B. SCATTERGOOD has been appointed to succeed Mr. T. A. Closs as manager for the Postal Telegraph Company at Atlanta. Mr. Closs goes to Augusta.

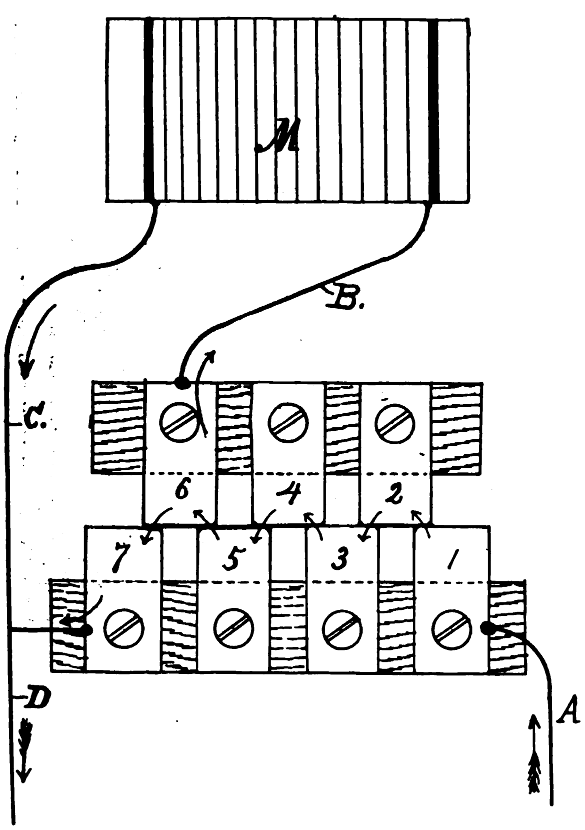
LIGHTNING ARRESTERS.

BY

Wm Baxter Jr

OF all the apparatus used in connection with electrical machinery, none has received more attention than, if as much, as the lightning-arrester; but, notwithstanding all that, the results obtained as yet cannot be said to be wholly satisfactory. A great many varieties of arresters have been tried, but in every case, so far as the writer is aware, the efforts of the designers have been directed entirely to providing means for breaking the ground connection should the line current continue to follow the path across the gap bridged by the lightning discharge. This is an important function of a lightning-arrester, but it is not the principal one; if it were, an ordinary fuse would serve the purpose perfectly well, except in the matter of convenience.

The principal object of a lightning-arrester is to provide a path for the discharge that will be so much easier than that through the insulation, that the latter will not be taken. To accomplish this result it is clearly evident that the circuit through the arrester must be of considerably lower resistance



BAXTER LIGHTNING ARRESTER.

than that through the insulation of the apparatus that is to be protected.

There are many engineers who claim that this is not the case; that lightning has no respect for Ohm's law, and will pick out a path to suit itself without any regard to the resistance. Those who hold such views give the law a narrow interpretation, and fail to see that inductive action is equivalent to ohmic resistance in so far as it impedes the passage of a current. When lightning strikes a line, the inductive action of any portion of the circuit that is wound in a coil, is very great, even though the number of turns be few. This is so simply because there is an instantaneous rise of current to enormous proportions, and therefore the rate of change of magnetic flux is infinitely great. On this account the reaction of even a small magnet coil is so enormous that it stops the current about as effectually as an open circuit. Such being the actual conditions, the available paths are through the ground circuit of the arrester, and through the insulation of the magnet coil, and the discharge will take the one that offers the least resistance. This being the case, it follows that the ground circuit through the arrester should be of as low resistance as is practicable, while every path through the insulation to ground should be obstructed as much as possible. The ground circuit in all properly designed arresters is free from coils, and as nearly non-inductive as it can be made, but this alone will not insure its effectiveness, as the width of the air gap may be enough to make the resistance through that path greater than through the insulation of the apparatus that is to be protected. The air gap ,as ordinarily constructed, cannot be made very narrow on account of the danger of its bridging across if the points should fuse under the action of a strong current. In some cases carbon points have been used to overcome this difficulty, but the objection to these is that if neglected the distance between them, after a few discharges have passed, will become too great to be effective. As the striking distance of the electromotive forces used in practice is very small, the width of the air gap could be reduced to two or three hundredths of an inch without danger of grounding the generator current, providing the gap could be kept at this distance, but this cannot be depended upon with the ordinary construction; therefore a considerably greater separation has to be used.

The writer several years ago designed a lightning-arrester in which the width of gap could be made very small, and the danger of actual contact avoided. The diagram given herewith shows the general principle of construction, but not the design, which it is needless to say can be varied to suit the requirements of any case.

The wire A is connected to the line, and the wire D to the ground. The pieces 1, 2, 3, 4, 5, 6, 7, are rectangular metallic contacts, about one inch long by half an inch wide and an eighth of an inch thick, all insulated from each other. The pieces 1, 3, 5, 7, are held on a block of insulating material which is attached to the base of the apparatus, and 2, 4, 6, are similarly held on a movable frame that carries an armature which is actuated by a magnet of which M is the coil. If the pieces 1, 3, 5, 7, and 2, 4, 6, are filed so that their ends are nearly in line, that is, as near as possible, without resorting to extreme accuracy, the points of contact, indicated by the arrows will be very close to each other, but not more than two will be in actual contact. The separation at the other points will be very small, ranging not over 100th of an inch, down to an invisible amount; but the combined resistance of these gaps will be sufficient to prevent the line current from jumping, while it will afford a lightning discharge a path of exceedingly low resistance, in comparison with that through the insulation of the apparatus that it protects.

The gap between 6 and 7 is filed so as to be wide enough to cause a current to be diverted through the coil M, that will be of sufficient strength to enable the magnet to actuate the armature which is attached to the frame that carries the contacts 2, 4, 6. When a lightning discharge passes the current goes across the gaps from 1 to 7 as indicated by the arrows, and thence to ground. If the line current should follow up the discharge, the resistance of the gap between 6 and 7 will send a current through the magnet coil, and the armature being attracted, the points 2, 4, 6, will be drawn away from the others until the resistance of the gaps becomes great enough to break the current.

When the contact points become rough, through the action of the current, they should be filed down so as to not have too great a separation.

The advantage of this construction is that the width of air gap can be greatly reduced, owing to the fact that the points that do not come in actual contact can be maintained in their position without any danger of grounding the line, as they are held from coming closer together by the points that are in actual contact. In addition to this, if one or more of the gaps should be bridged through any cause, there would still be two breaks in the circuit. When a single gap is used, its width must be very much more than is really necessary, so as to guard against grounding.

Lightning-arresters of the foregoing design have been used on railway cars with good results, and if kept in proper condition should always be effective. The greatest difficulty that had to be contended with in their use was to prevent the electricians of the roads from purposely making the gaps too wide, the general impression appearing to be that there was danger of grounding the line if this precaution were not taken. This fear, however, is groundless; in fact, with six breaks, as shown in the diagram, it is difficult to file the points so true that the current will jump with an e. m. f. of 500 volts.

To obtain the best results the number of breaks should be made in proportion to the electromotive force. As it is more difficult to obtain perfect alignment with a large number of contacts, it follows that the width of the gaps will be greater on an average as the number increases, hence the higher the e. m. f. the fewer in proportion the breaks.

ALTERNATE CURRENT TRANSFORMERS[1]—IV.

BY DR. J. A. FLEMING, F. R. S.

HAVING considered the action and construction of transformers, our next duty is to notice the principal facts connected with the testing of transformers. This is a matter of considerable importance. It is not too much to say that in very few alternating current stations is there any proper system of purchasing transformers to a rigid specification, and enforcing delivery to this specification by efficient methods of electrical testing. Engineers appear to be far too often quite content to accept manufacturers' figures without any confirmation. As

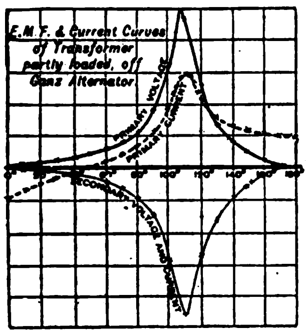


FIG. 34.

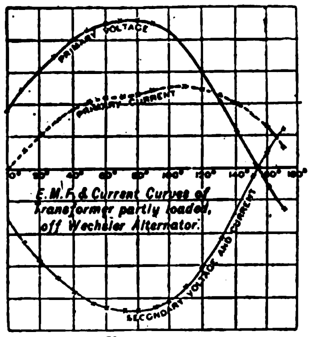


FIG. 35.

an instance of the possible consequences of such a course, I may, mention that not long ago I had occasion to specify for two transformers on behalf of a corporation, the core loss of these transformers was to be not greater than 550 watts when measured at the proper primary pressure, and on open secondary circuit. When the transformers were delivered they were tested. One of them was found to comply with the specification, the other took up 1,090 watts under the same circumstances. As these transformers were 30-kilowatt transformers, intended to be worked in a sub-station, and to be connected with the mains for at least 4,000 hours in the year, it is perfectly clear that if no test had been applied, and if the transformers had both been accepted, one of these transformers would have taken up 500 watts more than the other. This additional core loss, proceeding for 4,000 hours in the year, would have meant an addition to the magnetizing losses of 2,000 Board of Trade units per annum. As this would have involved an expenditure in coal and water of at least one penny per unit, the facts, translated into money, mean that one transformer would have cost something like £8 per annum more than the other to maintain magnetized. If this is capitalized at only 3 per cent. it means £240, whereas the actual cost of the transformers did not exceed £140 each. It is clear, therefore, that the omission of a systematic process of testing transformers and of specifying for them for test may involve a supply company or corporation in an increased annual expenditure for maintenance, which under some circumstances may even amount to a considerable sum. In dealing briefly with the subject of testing transformers I shall not attempt to describe all the many different methods which have been suggested, but confine myself shortly to one which is simple, direct, and can be applied in any sub-station or workshop. It should always be remembered that although an electrical method may theoretically give the required result, yet practically it may be difficult to get good results with it on account of the fact that to obtain the necessary accuracy we must assume an unattainable precision in some of the measurements. The method which, after long experience in this matter, I have found most applicable in all ordinary cases is one depending on the employment of a properly constructed wattmeter, standard power absorbing resistance, and an auxiliary transformer. We will discuss, in the first place, the construction of each of these instruments separately. If an alternating current is sent through a fixed coil of wire, and another current through a movable coil suspended with its magnetic axis at right angles to the first coil, the centers of the coils being co-incident, then in general we find an electrodynamic force tending to turn the movable coil from one position to another. If the initial position of the coils is with their magnetic axes at right angles, then the passage of the current tends to displace the magnetic axes so as to make them co-incident. If a couple or torque is applied to the movable coil to bring it back to its original position, either by means of a spiral spring or a torsion wire, it can be shown that the couple required to hold the coils in their initial position, with magnetic axes at right angles to one another, is proportional to the mean value of the product of the instantaneous values of the two periodic currents passing through the two coils taken at equidistant intervals throughout one complete period. This mean product, is therefore, at once measured in terms of a mechanical couple. Such an arrangement is called an electro-dynamometer. If the current through one of these coils is the current being supplied to an inductive circuit, say a transformer, and if the current through the other circuit, say the movable circuit, can be made to be proportional to the potential difference between the extremities of the inductive circuit, then the dynamometer, now called a wattmeter, will give us, when used as above described, the true mean value of the product of the instantaneous values of the current through the inductive circuit, and its terminal potential difference taken at equidistant intervals throughout the phase; this mean product is a measure of the mean power being taken up at that instant in the inductive circuit, and hence we are able by one measurement to measure this power. In order that good results may be obtained with a wattmeter constructed as above described when employing alternating currents, there are certain precautions which must be observed, but which instrument makers almost habitually disregard. In the first place, the wattmeter must be constructed entirely of non-conducting material. There must be no metal, either iron or brass, in or near the fixed or movable coils. The reason for this is, that if metal is placed in this position, the alternating currents circulating in the fixed or movable coils set up eddy currents in this metal, and these eddy currents react upon the movable coil, and cause a displacement which creates a false reading. In the next place, in order to make the instrument direct reading, it is essential that the fixed coil should be constructed in two parts, which are capable of being moved to or from one another, so as to strengthen or weaken the field in the place where the movable coil hangs. In this manner the wattmeter can be adjusted, so that a certain angular deflection of the torsion head of the instrument, creating a certain definite couple acting on the movable coil, can be made to mean a certain definite amount of mean power passing through the instrument. Thirdly, precautions must be taken to prevent the effect of the currents in the wires bringing the currents to or from the wattmeter affecting the movable coil. For this purpose these leads ought to be constructed of concentric cable, and the wattmeter carefully tested, before employment, to find out if this cause of error exists. In the next place we require a non-inductive resistance to act as a standard power-absorber. This can best be made by employing the cages as described in the first lecture. A series of these inductionless resistances, say, 20 of them, each capable of withstanding a pressure of 100 volts, are joined up in series, and well insulated. Under these circumstances, a pressure of 2,000 volts can be placed on the extremities of this resistance, and a certain current will flow through it. This current can be measured by a sensitive dynamometer, which has previously been calibrated in the usual way. The potential difference between the extremities of the non-inductive resistance when employed on a high-tension circuit is best measured by means of an electrostatic voltmeter. Then, lastly, we require an auxiliary transformer for the following purpose: It has been explained in Lecture I. that when a transformer of the closed iron circuit type is worked on a constant potential primary circuit, the secondary electromotive force set up in the secondary circuit is exactly opposite in phase to the primary electromotive force.

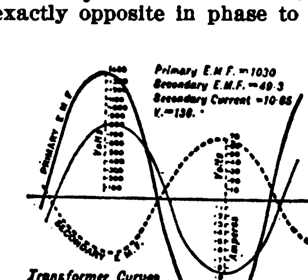


FIG. 36.

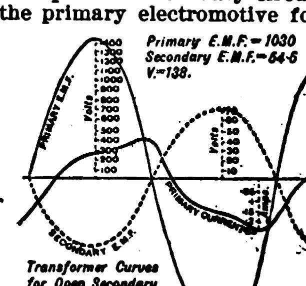


FIG. 37.

This is further illustrated by the curves in Figs. 34, 35, 36 and 37, which show the primary and secondary e. m. f. curves of a Ganz, a Wechsler, and a Westinghouse transformer in various conditions of load, and it will be seen that the primary and secondary e. m. f. curves are in step with one another, but opposite in phase. If, therefore, a transformer has its secondary circuit closed through a non-inductive resistance, the secondary current will always be exactly opposite in phase, but proportional in magnitude to the potential difference between the primary terminals of the transformer. In order, then, to make a measurement of the efficiency of any transformer, this apparatus is arranged as in Fig. 38, the transformer to be tested is denoted by the lines over the words "Transformer under test." The wattmeter has its fixed coils connected in series

[1] Society of Arts Cantor Lectures.

with the primary circuit of the transformer to be tested, and its movable coil is connected in series with the secondary circuit of the transformer, which is called the auxiliary or wattmeter transformer, and by including a few incandescent lamps, L, in the secondary circuit of this auxiliary transformer, the proper current can be given to the movable coil of the wattmeter. The primary circuit of the auxiliary transformer is connected to the same two mains as the primary circuit of the transformer to be tested, and an electrostatic voltmeter, V, is joined across the primary terminals of the transformer to be tested. The standard inductionless resistance just described is also placed across the primary terminals of the transformer to be tested, and a two-way high-tension switch is arranged so as to throw on the resistance, or the primary circuit of the transformer under test at pleasure. A dynamometer is connected in series with this standard resistance, to measure the current passing through it. The process of measuring the power supplied to the transformer under test is then as follows: In the first place we connect to the wattmeter the standard power of absorbing resistance, and observe the current flowing through it, and the potential difference between its extremities. The product of these two numbers in amperes and volts gives us the mean power in watts taken up in the standard resistance. At the same instant a reading of the wattmeter is taken; that is to say, an observation of the amount of torsion required to be given to the wire or spring holding the movable coil to bring it back into its normal position. Let this reading be D_1, and let the power taken up in the standard resistance in watts be represented by W_1. In the next place, the standard resistance is switched off, and the transformer under test is switched on to the wattmeter, and another reading is taken of the wattmeter. Let this reading be D_2. The true power being taken up in this transformer under test is given by the value of the expression $\frac{D_2}{D_1} \times W_1$. In this manner the wattmeter is employed as a kind of electrical steelyard, to weigh or measure the ratio between the known power taken up in the standard resistance and the unknown power taken up in the transformer.

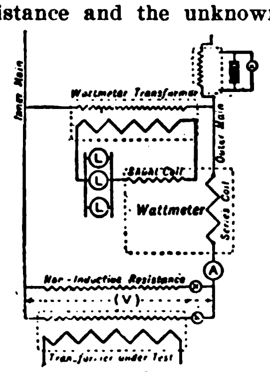


FIG. 38.

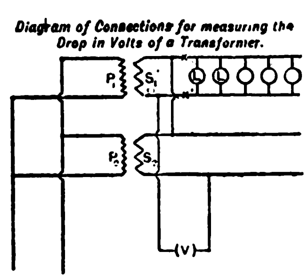


FIG. 39.

A measurement can thus be made with extreme accuracy, either in a central station, a transformer sub-station, or a private house. All that it is necessary to do is to connect the wattmeter, in the manner described, in place of one of the primary fuses; that is, to place the series coil of the wattmeter in series with the transformer under test, and then to connect up the standard resistance and the auxiliary transformer, as shown in the diagram. The iron core loss of a transformer on open secondary circuit can thus be quickly and accurately measured, and, with a properly constructed wattmeter of the kind described, there is not the slightest difficulty in making the measurement of the core loss of any required degree of accuracy.

The wattmeter before you and the standard resistances, have in this way been used for an extensive series of measurements on the efficiency and core losses of the transformers of the City of London Electric Lighting Company. No difficulty was found in making these measurements, even in the small underground sub-stations which are distributed about the city. In addition to the iron core loss of the transformer on open secondary circuit, it is also necessary to make two other measurements; one of these is the copper resistance of the two circuits of the transformer when the transformer is warm. The most easy method of doing this is by means of the fall of potential method. When the resistance of the primary circuit is moderately high, say, anything over 5 ohms, it can be very easily measured on the ordinary post office wheatstone bridge, taking the precaution, however, to short circuit the secondary circuit, but in those cases in which the resistance of either or both circuits is very low, then it is best measured in the following manner: A suitable standard low resistance, either 1-100th or 1-10th of an ohm, or 1 ohm is connected in series with the transformer circuit to be measured, and a small current from a dry cell or secondary battery is sent through this circuit, appropriate resistance being added to increase the total resistance to a proper amount. A movable coil high resistance galvanometer has its terminals then connected first to the extremities of the standard low resistance, and second to the terminals of the copper circuit of the transformer which is under test. The ratio of these two deflections gives us at once the ratio of the transformer circuit to that of the standard low resistance, and in this manner the copper resistance of each circuit of the transformer can be measured. This copper resistance, of these two deflections gives us at once the ratio of resistance however, if measured at the ordinary temperature of the air has to be corrected to determine what it is when the transformer has reached its constant temperature. When a transformer is put to work, whether on open circuit or closed secondary circuit, it soon reaches a final temperature which ought never, under any circumstances, to be more than 100° C. In order to determine what this temperature is, one of the easiest methods is to connect the transformer on open secondary circuit for five or six hours to the high pressure circuits, and when the transformer has reached its final and constant temperature to suddenly switch it off, and quickly make a measurement of the copper resistance of the secondary circuit, as above described. Then, when the transformer is quite cold, another measurement of the copper resistance may be taken, which will be found to be much less, since the high conductivity copper employed in transformer manufacture has a temperature coefficient of about 0.4 per cent. per degree Centigrade, it is very easy to calculate from these two measurements what is the final and constant temperature of the transformer. Having then measured the copper resistances, and calculated what it will be at the final temperature of the transformer, we have next to measure the secondary drop between full and no load. For this purpose an electrostatic voltmeter is connected across the secondary circuits, and its reading taken when the primary terminal potential difference is also known. The transformer is then loaded up to its full load on its secondary side, and the primary potential difference being kept at the same amount, the secondary potential difference will be found to have fallen, and the amount of difference between its value when the transformer is fully loaded and its value when the transformer is on open circuit is called the secondary drop. It is sometimes difficult to make this measurement with great accuracy, especially when the transformers are working off commercial circuits, but it can always be done in the way shown in the diagram in Fig. 39, if we possess two identical transformers, and a low reading electrostatic voltmeter. The two transformers are connected up with their primary circuits in parallel, and with their secondary circuits opposed to one another through the voltmeter. The voltmeter then reads, not secondary volts to either transformer, but the difference between the two differences. If one transformer is loaded up to full load, the voltmeter will read directly the secondary drop, and since both transformers are affected equally by any variation of the primary pressure, it does not affect their difference, and, therefore, there is no difficulty in getting the measurement with any required degree of accuracy. Having in this manner measured the iron core loss at no load, or on open secondary circuit, the copper resistances when the transformer is warm, and the secondary drop, we have all the information necessary to enable us to make a complete report on the transformer. It has been abundantly shown by experiments which were carried out by me in the year 1892,* that when a transformer is gradually loaded up, the iron core loss is constant at all loads, and that it is only the copper losses that vary. Hence, if we know the iron core loss—that is to say, the loss due to eddy currents and hysteresis in the core when the transformer is on open secondary circuit, we have only to add to this loss the copper losses in the transformer, that is, the energy losses due to the resistance of the copper circuits, in order to obtain the total power absorption in the transformer at any load. Let P_1 be the total power in watts given in a transformer on the primary circuit, and let P_2 be the total power in watts given out on the secondary circuit to some external resistances, such as lamps. Let I be the total iron losses in the transformer, and C the total copper losses, $P_1 = I + C + P_2$. Hence the difference between P_1 and P_2 is a quantity which can be calculated when we know I and know C; and the efficiency of the transformer is given by the ratio of P_2 to P_1, expressed as a percentage. The copper losses can be calculated with sufficient accuracy in the following manner: Let us suppose that the transformer under test is a 10 kilowatt transformer, that is to say, is constructed to permit 10,000 watts being taken out from the secondary circuit, and that the secondary watts are intended to be 100. Then the transformer at full load will give

* See "Experimental Researches on Alternate Current Transformers," by J. A. Fleming. "Proceedings of the Institution of Electrical Engineers," November, 1892.

out a current of 100 amperes. If we imagine the full load of the transformer to be divided into 10 parts, then when the secondary circuit is delivering 10 amperes at 100 volts the transformer is on 1-10th load, when it is delivering 20 amperes at 100 volts the transformer is on 2-10ths of full load, and so on. If the transformation ratio of the transformer is known, that is, the ratio between the secondary volts and the primary volts, or secondary terminal potential difference and primary terminal potential difference, when the transformer is on open secondary circuit, then the primary current can always be calculated with approximate accuracy from the secondary current by simply multiplying the secondary current by the number expressing the transformation ratio. Hence we can calculate the primary and secondary currents corresponding to each decimal fraction of full secondary load. Knowing the resistances of the two circuits of the transformer when warm, we can, therefore, calculate the copper losses in each circuit, because if R is the resistance of a circuit, and C the R.M.S. value of the current flowing through it, then C^2 R is equal to the mean power wasted in that circuit. Calculating in this way the total copper losses for the two circuits corresponding to each decimal fraction of the full secondary load, we can add these values to the constant iron core loss experimentally determined, and obtain the total power lost in the transformer, corresponding to each decimal fraction of the full secondary load, we can add these values to the constant iron core loss experimentally determined, and obtain the total power lost in the transformer, corresponding to each decimal fraction of full load. We have, therefore, the difference between P_1 and P_2, corresponding to known values of P_2. Hence we can calculate the ratio of P_1 to P_2 for each decimal fraction of the full secondary load, and, therefore, we have the efficiency of the transformer and the total loss in the transformer given to us at each fraction of the full secondary load. This is by far the best method of determining the efficiency of very large trans-

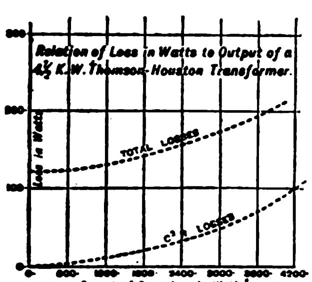


FIG. 40.

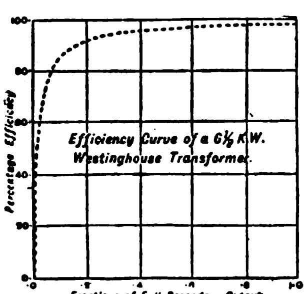


FIG. 41.

formers, because it does not necessitate loading up the transformer to its full load on an actual resistance; and even if this can be done, the measurement which we actually require is the difference between two large observed quantities, and is, therefore, very liable to be affected by an error in either of them. Having obtained in this manner the total losses in the transformer for the various decimal fractions of the full secondary load, the most convenient graphic method of representing the results is by a total loss diagram. A horizontal line is taken, and is divided into 10 equal parts representing the decimal fractions of the full secondary load. At each part a vertical line is set up, representing the total losses in the transformer, both the copper and the iron losses, and two curves are drawn, as in Fig. 40, one representing the variation of the total copper losses in the transformer with the secondary load, and the other representing the constant iron loss at all loads. From this curve another curve, called the efficiency curve, can be drawn in the following manner (see Fig. 41). A horizontal line is taken, representing the secondary output, and divided into ten equal parts representing the decimal fractions of the full secondary load. At each point a vertical line is set up, representing the ratio between the power given out by the transformer to the power taken in by the transformer, expressed as a percentage, and the curve delineated by these points gives us the efficiency curve of the transformer. In a well-designed transformer this efficiency curve is a square-shouldered curve, rising very rapidly up to 90 per cent. at one-tenth of full load, and to 96 or 97 per cent. at full load. A fairly good estimate of the value of a transformer, from an efficiency point of view, can be obtained by taking its efficiency at one-tenth of full secondary load. Even quite small transformers are now made which have an efficiency of 80 per cent. at one-tenth of full load. Large transformers of 30 to 50 wilowatts and upwards can be made to have an efficiency of 90 per cent. at one-tenth of full load. Ten years ago it was difficult to get any transformer having more than 40 to 50 per cent. of efficiency at one-tenth of full load.

It should be noted, however, that the form of this efficiency curve, as well as that of the current curve, depends upon the nature of the curve of primary e. m. f. The diagram in Fig. 30, chapter III., shows the difference which may exist in the efficiency curves in the case of the same transformer tested in two different alternators, a Ganz and a Wechsler.

In considering the performance of transformers, we are not only concerned with the instantaneous efficiency—that is, the efficiency under any particular load—but with what is called the all-day or all-year efficiency. This can be calculated when we know the efficiency of the transformer at various loads, and when we know the nature of the load diagram, as it is called, on which the transformer is supplied. Thus, for instance, let us make the assumption that the load diagram of a transformer is a 10 per cent. load diagram—that is to say, let us assume that out of the 24 hours, for 11 hours the transformer is giving no current from the secondary circuit, for five hours is supplying at one-tenth of its full secondary output, for four hours one-eighth, for three hours one-quarter, and for one hour three-quarters. It will be found, on adding up these outputs, that they amount to one-tenth of that which the transformer would be supplying if working at its full secondary output for the whole 24 hours. Let us take, then, the case of a 24-hour kilowatt transformer, having 1.35 per cent. loss on open secondary circuit, and 1.35 per cent. — 1.60 per cent. loss at full load. This gives an open circuit loss of 324 watts at no load; that is to say, 324 watts is the core loss in the transformer at no secondary load; the efficiency at one-tenth full load is 86 per cent. and at full load 96 per cent. From the total loss diagram it can then be shown that the transformer takes up in its primary circuit 324 watts on open secondary, 2,762 watts at one-tenth of full load, 3,372 watts at one-eighth of full load, 6,420 watts at one-fourth full load, and 18,162 at three-fourths of full load. We can then construct an energy balance-sheet for the transformer as follows, putting on one side the energy in watt-hours given by the primary circuit, and on the other side the energy in watt-hours taken from the secondary circuit, and these figures will be as follows:

Energy in Watt-Hours Given to Primary Circuit.

11	×	324	=	3,564
5	×	2,762	=	13,810
4	×	3,372	=	13,488
3	×	6,420	=	19,260
1	×	18,612	=	18,612

Total = 68,734 Board of Trade units.

Energy in Watt-Hours Taken from Secondary Circuit.

11	×	0	=	0
5	×	2,400	=	12,000
4	×	3,000	=	12,000
3	×	6,000	=	18,000
1	×	18,000	=	18,000

Total = 60,000 Board of Trade units.

CONTEMPORARY ELECTRICAL SCIENCE.

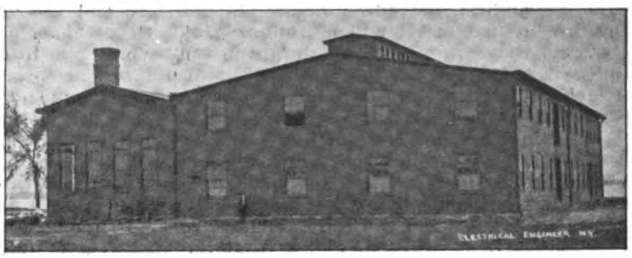
"Il Nuovo Cimento" for July contains some very interesting contributions. A. Garbasso writes about the discharge of a cathode by flame gases. The products of combustion of a candle give rise to exactly the same phenomena in the spark-gap as those produced by Röntgen rays and by ultra-violet light. They promote the discharge when impinging upon the cathode, but produce no effect upon the anode. If a glass plate is brought between the knobs so that the discharge can only just pass round the edge, a candle placed below the cathode on one side of the plate produces a shower of sparks, while when placed under the anode it stops the discharge altogether, if anything. This action is not due to the heat of the flame. The gases can be led up to the knob through a tube 40 cm. long, and the tube can be immersed in cold water, without altering the effect. Besides, a current of hot air does not produce the effect described, whereas it may be brought about by the smoke from a cigarette. Signor Garbasso suspects that the discharge produced by ultra-violet and X-rays may be a secondary effect, and may be due, as in the case of a flame, to the action of electrified particles in the shape of dissociated molecules. Dr. Maiorana gives the results of his studies of the effect of light upon the resistance of selenium. He finds that the effect is anything but "instantaneous." The resistance of a piece of selenium, with a normal resistance of 258,100 ohms, was lowered in the first second of illumination to 224,000, in the second to 212,-000, and after that it gradually approached a limit of about 200,000 ohms. The recovery proceeded equally gradually. We also find a description of the new system of electrical distribution patented by Profs. Ferraris and Arnò. The system is to provide for the case when the same current has to be used for lighting and power to nearly the same extent. The ordinary alternate current is sent through the lamps, and the power portion is transformed so as to suit the requirements of polyphase motors. This is done by the "phase-difference transformers" designed by the inventors.—London "Electrician."

Power Transmission.

THE MANUFACTURE OF CHEMICALS BY NIAGARA POWER.

BY ORRIN E. DUNLAP.

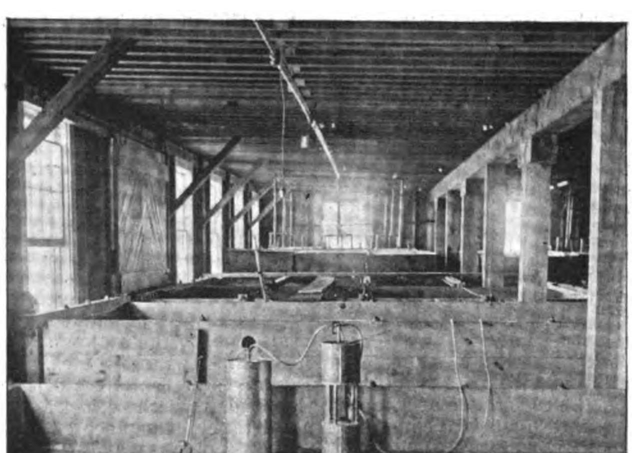
THE new plant of the Chemical Construction Company, of Niagara Falls is now in operation. This factory is located further east than any other plant on the Niagara Falls Power Company's lands and is therefore more distant from the power house than are the other factories built there. This company will make chlorate of potash, chlorate of soda, chlorate of barium, etc., while later on they expect also to make chloroform



Chemical Construction Co.'s Factory, Niagara Falls.

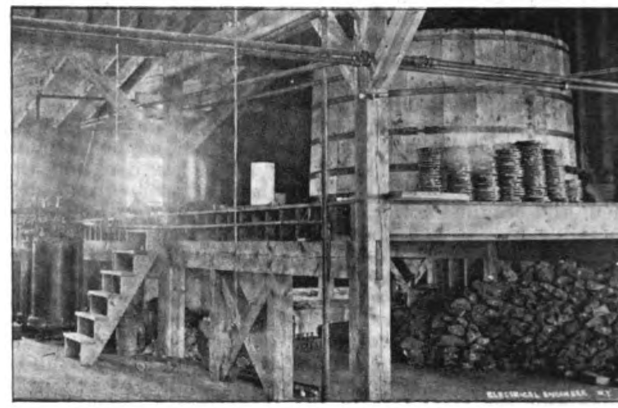
and iodoform. Eight acres of land have been leased from the Niagara Falls Power Company, and the power lease makes available 4,000 horse-power. At present only 500 horse-power is in use, and the factory covers but a small proportion of the land leased. It will thus be seen from these facts that the company have made ample provision in the matter of power and space for the enlargement of their plant in accordance with the dictates of their judgment and the demand for their goods. As it stands to-day the plant is composed of three frame buildings, the main structure being two stories high, 125 feet long by 65 feet wide, and the transformer house 60 feet long by 40 feet wide. This building is also two stories in height. The third building is used as a storage building and is located in the rear of the main building.

The process is started in dissolving the muriate of potash in five large tanks, each 10 feet in diameter and 6 feet deep, each having a capacity of 3,000 gallons. These tanks are located in the rear of the main building, two of them being in the storage room. From these tanks the solution is pumped by steam to the upper floor of the main building, where it passes through filters made by the Continental Filter Company of New York, and then into a storage tank of 4,000 gallons capacity. From this tank the solution is tapped off for use in the pot room, 90 x 65 feet in size and which is also on the second floor, as



Tank Room on First Floor.

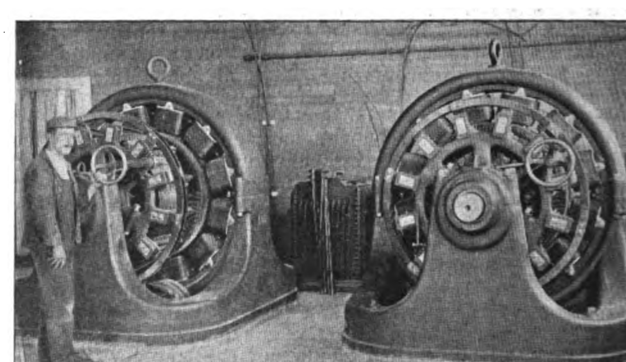
needed. This pot room is an interesting place. The switchboard is on the east side of the building and above the transformer room. In addition to this main switch each pot has a switch by which it can be thrown in or out of circuit. The iron pots are sixty in number and porcelain lined. They are said to be the largest porcelain lined tanks ever made in the United States and the largest ever used for this purpose. In length they are about 8 feet, the width being 4 or 5 feet, which makes a large casting. They were made by Messrs. Dawes & Myler, of New Brighton, Pa., and it is said the shrinkage between the iron and the porcelain lining was so much as to cause considerable trouble in their manufacture, but as they stand to-day they are fine samples of good work. The pots being all insulated one from the other and also from the floor, there is no danger of shock of any kind. It is in these pots or tanks that the muriate solution is decomposed, forming the chlorate which is allowed to run down to the first floor into porcelain lined crystallizing tanks or pans, then into lead lined pans and finally into a wooden pan, after which it is shovelled



Storage Tank and Filtration Plant.

up and thrown into a centrifugal dryer, where the moisture is driven by centrifugal force. It is then placed in the dry room where the remaining moisture is removed, after which it goes into the packing room where it is put up in 100-pound kegs and sealed for shipment. The operation from the time the muriate solution enters the pot room to the time the chlorate is ready for shipment consumes about twenty-four hours, the process being continuous night and day, the factory being operated in shifts of twelve hours each. The present capacity of the plant is about one ton of chlorate of potash per day.

The electrical equipment of this factory was manufactured by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. It consists of two rotary transformers of 250 horse-power each, and four static transformers, which give 3,000 amperes at 60 volts. The current is supplied by the Niagara Falls Power Company and flows to the factory over cables laid along the ground, the subway not yet being extended to this point. As it is received at the plant the current is of the two-phase alternating variety at 2,200 volts, which is converted into direct current by the rotaries shown. No other factory in Niagara Falls uses quite so much copper for conductor purposes as is found in the plant of the Chemical Construction Company.



Transformer Room.

From the transformer building twelve copper bars, each 5 inches wide by ⅝ inch thick, carry the current to the main building where it is distributed to the sixty pots on copper bars 4 inches wide by ½ inch in thickness.

Those who have watched electrical progress in America know that this is the first factory of its kind in this country and that its erection is the birth of a new industry on this continent, for not one ounce of chlorate of potash is made by chemical or other process in the United States outside of Niagara Falls.

In England and other European countries chlorate of potash is made by chemical process, but this Niagara Falls factory is expected to revolutionize several fields of manufacture in the chemical industry. To-day chlorate of potash is worth from nine to ten cents per pound, wholesale, in net ton lots, the supply for the United States coming mainly from Germany, England, France and Switzerland. The consumption averages five million pounds per year in the United States alone. Since the passage of the McKinley bill no duty has been imposed on it, but before that time the duty was three cents per pound. The uses of chlorate of potash are very numerous. It goes into parlor matches, blasting compounds, and smokeless powders. It enters into alizarine dyeing and all the various colored lights and also torpedoes. It is used in making cough mixtures and other medicines, oxygen gas, and as an oxydizer generally.

The electrical process established at the Falls offers, it is said, many advantages over the old chemical process, one being that there are no by-products, each and every atom of salt used being converted into chlorate. By the chemical process chlorate of potash is made in a roundabout way, by which there are two or three by-products, all unsaleable. More than this, five out of six equivalents of salt are lost, while in the electrical process there is no waste whatever. So thorough is this economy that the floors of the pot and crystallizing rooms are asphalted and have a pitch of one inch in four from both sides toward the center to catch all drippings from the pots, which are carried to two tanks outside of the main building to be filtered and used again.

The salt to be used in chlorate of potash is imported from Stassfurt, Germany. It comes in bags of 224 pounds each and is known to the trade as muriate of potash, the correct name being chloride of potash. Stassfurt, strange to say, is the only place in the world where this salt is found, and there is mile after mile of it, the supply being practically unlimited. It is likely that the other salt to be used in this factory will be brought from Syracuse, N. Y.

Further advantages of the Blumenberg electrical process are the extremely low voltage used, the peculiar construction of the cell which gives a very high efficiency and the use of carbon anodes in place of platinum. In addition to all of which, the cost of production will be much less than by the chemical process.

Statistics on the manufacture of chlorates in various countries are very meagre. England, France, Germany, Switzerland and Austria are all interested, and for England some data exists showing that up to 1879 in that country the production of chlorate of potash was about 1,400 pounds per year by chemical process. Since then progress has been made in the amount produced, but there has been no special change of the method. To-day, chlorate of potash is made by three electrical processes. These are the process employed by Gall & & Montlauer, of France; Franchot & Gibbs, of Buckingham, Canada; and that of the Chemical Construction Company, of Niagara Falls. Both of the first named firms, it is understood, use platinum, which is more costly than the carbon of the latter. M. Kolbe, of Germany, was the first to demonstrate the possibility of producing chlorates by electroysis, but the fact was also noticed about the same time by John T. Sprague, of Birmingham, England, who refers to it in his well known book. The establishment of this and other plants of like nature at Niagara Falls well supports the statement of M. Lunge, Professor in the Ecole Polytechnique at Zurich, Switzerland, who has expressed faith in the future of countries of great hydraulic power, and who has said these countries would be the center of all new electrical methods.

The capital stock of the Chemical Construction Company is $75,000. The president of the company is Mr. W. Ferguson, of New York. The vice-president of the company is Mr. W. T. Wilson, and the secretary is Mr. B. Hoes, both of New York. The general manager of the company is Mr. Frederick Overbury, a pleasant, affable young gentleman, who, with Mr. Henry Blumenberg, Jr., the patentee of the process, has had full charge of the important duty of equipping the Niagara Falls plant. For all Mr. Blumenberg is a young man, he is very brilliant, and his name and field of research and invention are well known in the patent office at Washington, D. C. He has been granted four patents on electroysis since April 2, 1895, the last bearing date of Aug. 4, 1896.

NEWS AND NOTES.

THE ST. LAWRENCE RIVER SEARCHLIGHT TRIP.

IT is a generally admitted fact that the attractions offered by the scenery and waters of the St. Lawrence River are equalled by few other resorts. The neighborhood is the summer home of thousands of cottagers, and as many more, as tourists, make this their stopping place for shorter periods while in quest of recreation and pleasure.

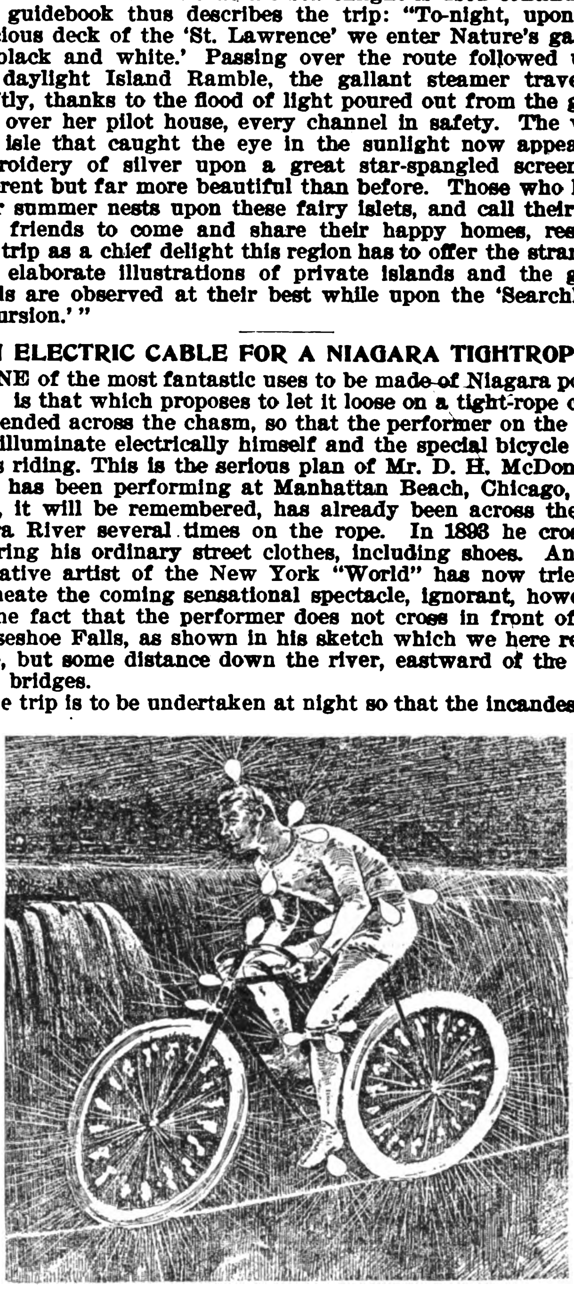
One of the prominent features of the river is the "White Squadron," the fleet of the Thousand Island and St. Lawrence River Steamboat Companies, consisting of the "St. Lawrence," "Empire State," "America," and "Islander," all side-wheel boats of goodly proportions. Besides these, the propeller, "New Island Wanderer," the swiftest boat on the river, makes regular trips. All of these boats are equipped with electrical plants, consisting of Westinghouse engines, belted to high speed dynamos of various makes, neat and compact switchboards, with ammeters and voltmeters, and on the pilot house of each boat is erected a large searchlight, those on the "St. Lawrence" and "America" said to be of 1,000,000 candle power each. The boats are lighted by 250 incandescent lights, making the interior as bright as day.

The "New Island Wanderer" and "St. Lawrence" make regular trips during the season from 8 to 11 p. m. among the islands between Clayton and Alexandria Bay. The novelty of the trip is due to the fact that the searchlight is used continually. The guidebook thus describes the trip: "To-night, upon the spacious deck of the 'St. Lawrence' we enter Nature's gallery of 'black and white.' Passing over the route followed upon the daylight Island Ramble, the gallant steamer traverses swiftly, thanks to the flood of light poured out from the great lens over her pilot house, every channel in safety. The vista and isle that caught the eye in the sunlight now appear in embroidery of silver upon a great star-spangled screen, so different but far more beautiful than before. Those who have their summer nests upon these fairy islets, and call their distant friends to come and share their happy homes, reserve this trip as a chief delight this region has to offer the stranger. The elaborate illustrations of private islands and the great hotels are observed at their best while upon the 'Searchlight Excursion.'"

AN ELECTRIC CABLE FOR A NIAGARA TIGHTROPE.

ONE of the most fantastic uses to be made of Niagara power is that which proposes to let it loose on a tight-rope cable suspended across the chasm, so that the performer on the rope can illuminate electrically himself and the special bicycle that he is riding. This is the serious plan of Mr. D. H. McDonnell, who has been performing at Manhattan Beach, Chicago, and who, it will be remembered, has already been across the Niagara River several times on the rope. In 1893 he crossed, wearing his ordinary street clothes, including shoes. An imaginative artist of the New York "World" has now tried to delineate the coming sensational spectacle, ignorant, however, of the fact that the performer does not cross in front of the Horseshoe Falls, as shown in his sketch which we here reproduce, but some distance down the river, eastward of the railroad bridges.

The trip is to be undertaken at night so that the incandescent



CROSSING NIAGARA ON A LIGHTING TIGHT ROPE CIRCUIT.

lamps on the rider and wheel will show up brilliantly. The rubber tire is removed, and the metal rope will fit the groove of the tire, thus making contact and delivering 500 volt current. At Manhattan Beach, Chicago, McDonnell's belt got short-circuited, when he was badly burned about the breast and back. Should anything of the kind happen while he is swaying out over the rushing torrent, two hundred feet in midair, the consequences might be disastrous. The current is to be supplied from one of the plants in the vicinity run by Niagara.

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STEAM TURBINE ECONOMY.

THERE never was a time when the economies of central station working were looked after more sharply than they are at present, and still, if we may judge from the statistics available, the coal consumption in American central stations on the average is frightfully high. We believe it may be fairly assumed that in the majority of cases the blame of the avoidable loss may be attributed to the engine rather than to the boiler. But even assuming it to be evenly divided between them, enough would be left to put the engine in the position of an habitual offender. The rapid introduction of compound and triple expansion engines of late years, more particularly in the larger stations, has brought the engine economy in many cases within limits closely approaching the best marine practice, but the rank and file of American stations still worry along under conditions which tend to make the earning of dividends harder and harder every year, and not a few have already undertaken to remodel their plant thoroughly and substitute more efficient apparatus, entailing, in many instances an expense equal to the original outlay. Whether it is a case of remodeling or of entirely new construction the engine must always command its due share of attention. American engine builders have not been slow to recognize this, and engine users have appreciated their efforts by a liberal and ready adoption of the new types of engines which the electric light and railway enterprises have called into life. Yet it would seem that so far as one particular type of engine is concerned, it has been entirely ignored in spite of the fact that for ten years past its use in England and on the Continent of Europe has been steadily extending. We refer, of course, to the steam turbine. Two principal types of these engines have been brought out, the Parsons, which is in quite extended use in England, and the De Laval, which has more recently been gaining ground on the Continent. We had long been waiting for the first step towards a trial of these machines in America, and this has at last been undertaken by the New York Edison Company, to whom the electrical industries of the entire country are already much in debt for their pioneer work. The results of the tests of the De Laval steam turbine in the New York Edison station—all things considered—must be taken as eminently satisfactory. It is quite true that 19.25 pounds of steam per horse-power hour has been considerably exceeded by triple-expansion electric lighting engines, but these, as a rule, have been of very much larger power than the De Laval turbine under discussion. More significant than the figure of maximum economy shown, is the high, sustained duty at light load. It is this feature which will commend itself, it seems to us, more particularly for isolated plant work, in which, as a general thing, light load is the rule. But besides its unquestioned economy in steam consumption, the steam turbine also lays claim to economy of space occupied for a given power. In this respect it stands unrivalled, owing, of course, to the high speeds at which it is operated; this consideration may be a dominating one in many instances. The steam turbine has already made a sufficiently good record to establish its claim to recognition, and we are glad to know that an American firm has undertaken to build this type of engine.

ERRONEOUS IDEAS ABOUT STREET RAILROADS.

THE recent passing of the Kings County Elevated Railroad of Brooklyn into the hands of a receiver has led the "New York World" to arrive at the conclusion that the elevated fares in New York ought to be reduced to three cents. This is based on the statement of the road's treasurer that the first year after the trolley system was introduced in Brooklyn the company lost $120,000, owing to the new competition; and though some of this was regained during the famous trolley strike, the reflux of travel was only temporary. It seems to us that this is puerile and grotesque reasoning, if it can be dignified by being regarded as serious argument. It is hard to

see what the condition of affairs in Brooklyn has to do with that in New York. As a matter of fact the New York elevated has felt the competition of the surface cable cars to such an extent that any reduction in its rate of fare would probably stop the payment of dividends and might even throw it into bankruptcy.

Meantime, as the "World" was such an abusive foe of the trolley, it is interesting to note its concession that "People are using the electric cars, not because they love their management, but because electricity undoubtedly stands for progress and increasing concessions to public convenience."

Another point in regard to which the "World" needs fuller information is the cost of street railway construction. It speaks of the average capitalization of the street lines at $95,-600 a mile as "an extreme case of inflation," because the rate for the steam roads is only $62,951 per mile, and because "the cost of constructing the average mile of steam railroad track is, of course, much greater than that of laying the average mile of street railway track on a roadbed already prepared and not ballasted." All this, again, has nothing to do with the case, the figures being the capitalization per mile and not the mere cost of track construction, which is but one item and leaves out of account rolling stock, power plant, real estate, and lots of other things. This the "World" either does not know or prefers to ignore. But even on the individual point of track construction, the "World" and its readers should know that it is grossly in error, as the average cost per mile of a street railway is very high, in almost any city that can be named, above 10,000 inhabitants. In cities like New York it runs into enormous figures, and in many places has to include the reconstruction and paving of the whole street between the curbs. Hence, on this point again, the "World" is wrong in trying to base an argument for three-cent fares. No doubt there has, in some instances, been over capitalization by street railroads. So there has been by farmers, and hence we have the silver craze. It is a common mistake to overestimate earning capacity and capitalize it and go into debt on it. But in the case of the railroads three-cent fares are no cure, for most of them could not operate at that rate, and the public would thus lose heavily both as to its investment and as to its facilities for locomotion.

TELEPHONE SWEARING.

IT seems to us that a question of fact is broadly involved in the accusations recently made in one of the New York newspapers and quoted by us last week, to the effect that owing to the badness of the local telephone service, those who used the instruments were more grossly profane than any other people in the city. There are two definite charges or indictments here. One is that the service is very bad. The other is that New Yorkers have so little self-control that they lose their temper and good manners whenever they handle the telephone.

Taking up the latter accusation, we venture to say that it is wholly untrue. Our inquiries of the telephone managers do not go to show that anyone has been cut off, as the rules provide, for use of foul language; in short, there are no statistics on the subject because the alleged practice of indecent profanity does not exist. But admitting that the telephone management would wink at such conduct because provoked by its own incompetent service, we must appeal to the experience of our readers and ask them whether among the ten or twelve thousand local subscribers they have heard a single one of them swear, and that profusely, at the telephone or through it, because the service was bad. We have made inquiries and investigation on this point ourselves, and cannot carry home the proof of a single "cuss word." It is, moreover, one of the well known facts that New Yorkers are mild mannered men of soft speech. They do not swear horribly like the English troops in Flanders or like Governor Tillman, of South Carolina, in advocating anarchy and repudiation. If they have to put up with temporary inconvenience or annoyance, they are wont to laugh it off altogether too easily. A New Yorker will endure without murmur things that Londoners or Parisians would not stand for five minutes, as affecting comfort and getting the value of their money.

Coming to the question of the quality of the service, we do not hesitate to characterize it as good, and as being generally of remarkable excellence. We say this after testing kindred service in most of the cities in this country and several cities of Europe. On the pro rata basis, a subscriber can now limit his expenditure to the exact number of calls, and anybody who really needs a telephone can afford to put it in.

ELECTRICITY DIRECT FROM COAL.

LACKING one year it is just three-quarters of a century since Seebeck demonstrated that an electric current is generated by heating the junction of two dissimilar metals. When one stops to consider that this discovery antedates Faraday's discovery of magneto-electric induction by nine years, and when one contemplates the vast extent to which the latter has been applied in practical work, one is impressed with the fact that the germinating power of ideas is subject to wide fluctuation. We are not unmindful of the fact that theoretical considerations have limited the activity in the field of thermo-electric work, but even this would scarcely serve to explain the slow advance which marked its progress from the beginning. Happily the work of the last twenty years in other departments of electricity has again given a stimulus to the search for a method of direct production of electricity from coal or other forms of fuel derived from it, and indications are not wanting that substantial advances have been made, if not towards a general utilization of some of these methods, at least in their adaptation to many useful and important applications involving the use of electric current.

The type of apparatus which may be said to be advanced farthest beyond the laboratory stage is the thermo-electric generator of Mr. H. B. Cox, already noted in our columns, and the description which we give in this week's issue of the factory constructed for its manufacture in England is sufficient evidence of works backed by faith. The salient feature of the Cox generator is the nature of the joint between the dissimilar metals, which has invariably been the weak point in previous constructions of this nature. The length of time during which some of Mr. Cox's generators have been at work may well be taken as good evidence that the question of durability and power to stand up to its work is disposed of.

The question which naturally forces itself to the front in the application of a new apparatus designed to replace older types is, "What will it cost to operate?" On this point the figures given by Mr. Cox shed considerable light. Taking the 12½ watt generator to consume 2½ cubic feet per hour, 1,000 cubic feet of gas, would, therefore, furnish 5,000 watt hours. With ordinary city gas at $1.25, this figures out at 25 cents per 1,000 watt hours, or 1 cent for 40 watt hours. This rate, while not as low as that obtaining in some cities, nevertheless compares favorably with that charged in many smaller towns, and when it is considered that producer gas, costing far less than $1.25, and oil, may be employed, instead of the more expensive illuminating gas, the possibilities of the new thermo-cell are at once apparent. The comparison of cost of current just made refers, of course, only to current generated by steam power. When we take into account the many uses to which galvanic batteries are still put and compare their cost of operation with that of the thermo-generator, the difference is so striking in favor of the latter that no special calculation is necessary to demonstrate it. As to the cost of Cox thermo-generators we are informed that a horse-power equipment could be installed at a price not exceeding that of a steam engine and dynamo equipment of like power. Of course we are here giving the figures and data furnished us by the inventor, who is perfectly willing to stand or fall by them. Taking them as they stand, however, we may yet hope to see electricity direct from coal well realized before the close of the century.

EDISON TELEPHONES.

IT is rumored that Li Hung Chang is anxious to get telephones and phonographs from Mr. Edison. If this be true, there is little doubt that the inventor is ready and willing to supply the needed commodities. Phonographs he has, we all know, and unless his right hand has lost the cunning which enabled him to turn out the two or three hundred types of telephone, of which specimens were shown at the Lenox Lyceum six years ago, he should be well able to furnish telephones as well. Mr. Edison by this time should also be free from the old contracts that checked his ardor and literally threw him out of the telephonic business.

Thermo-Electricity.

THE COX THERMO-ELECTRIC GENERATOR.

It is now about eighteen months ago that The Electrical Engineer first described[1] a type of thermo-electric generator devised by Mr. Harry Barringer Cox, of Hartford, Conn., in which that gentleman had embodied the results of many

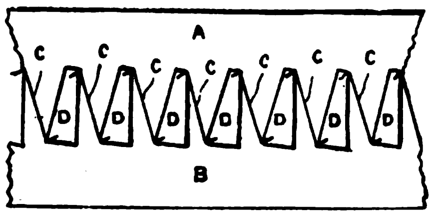
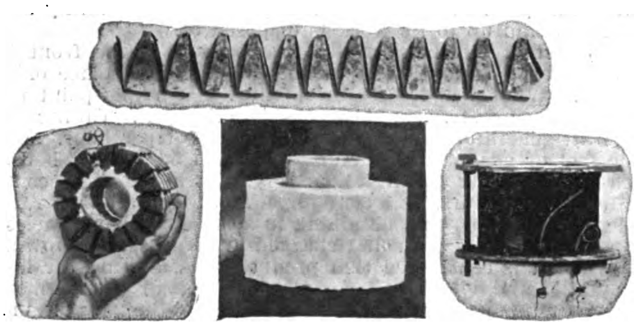


Fig. 1.—Mould for Casting Cox Thermo-Elements.

years of study and experiment and which far surpassed in efficiency and economy anything which had theretofore been accomplished in the direction of thermo-electric current generation. Although the invention was worked out on American soil, circumstances, the details of which need not be entered into here, have led to the establishment of the first factory for the manufacture of the Cox thermo-electric generators in England, and a brief description of the Cox laboratory and works at St. Albans, Herts, will, without doubt, prove of interest, as it represents the largest individual works of the kind in the world devoted to the manufacture of thermo-electric generators.

Before proceeding to describe the process of manufacture, it may be well to recall that Mr. Cox has achieved his present success chiefly by recognizing and overcoming the main difficulty heretofore encountered in thermo-electric generators, namely, oxidation at the joint, with its attending increase in resistance with lapse of time. In the Cox generator this defect is overcome by having practically no real junction point. This is brought about by graduating or shading the two alloys composing the element into each other so that there is practically



Figs. 2, 3, 4 and 5.—Cox Thermo-Electric Element in Various Stages of Construction.

no definite point of junction. Oxidation of such a junction is evidently impossible, and hence is explained the constancy of its action after a use, in some instances, of five years.

Mr. Cox employs in his generator a couple, one element of which is an alloy of antimony and zinc, and the other of copper and nickel, each couple giving .08 volt. A sufficient number of couples to form one ring or tier in the generator are cast together in a mould of peculiar construction. The mould is made in two parts, A and B, Fig. 1, each half being a steel plate with pointed teeth on one of its edges. When the two parts of the mould are placed together, the teeth intermesh as in toothed gearing, and grip the short copper plates, C, which form the positive elements, between their bearing surfaces. The clearance left between the back of one tooth and the face of the tooth next following, forms the moulds or cavities, D, into which the antimony alloy forming the negative element, is cast. The ends of each copper element are bent round so as to lie across the ends of the cavities into which the antimony alloy is poured.

The fused antimony thus comes directly in contact with the copper plates, but this would not be sufficient to make a good joint if the metal were allowed to cool in the ordinary way. Since the fusing temperature of the antimony alloy is about 300° and of the copper 1,000°, a strong welded or alloyed joint could evidently not be secured at the lowest fusion temperature. The desired result is effected, however, and a true welded point produced between the antimony and the copper by heating the steel moulds to a high temperature before casting, and maintaining them at this temperature for a considerable time thereafter. A gradual process of alloying thus takes place between the fused antimony and the copper at their surfaces of contact; a certain percentage of copper penetrating into the antimony, and a certain percentage of antimony into the copper. The stratum of metal which forms the junction of the two elements varies uniformly in composition from that of the positive element at the one side to that of the negative element at the other.

The element after it leaves the casting mould is shown in Fig. 2; in this form it undergoes a careful annealing until the antimony alloy, which, after casting, is quite brittle, becomes tough and can be readily handled without danger of breaking.

After the annealing process is complete each strip is tested

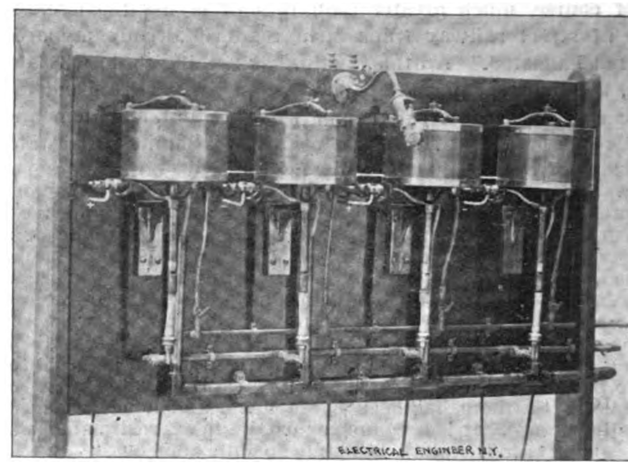


Fig. 6.—Fifty-Volt 5-Lamp Outfit of Cox Thermo Generators.

for resistance, and a variation of but one-thousandth of an ohm, indicating a defect in casting or annealing, leads to the rejection of the strip.

The straight strip or series of couples, after passing the resistance test satisfactorily, is bent into circular form, in the manner shown in Fig. 3, each such ring of elements constituting a tier in the finished generator. In order to prevent corrosive and disintegrating action of the gas flame, the rings of elements, together with their connections, are covered with a vitreous enamel, the element having then the appearance shown in Fig. 4.

The enamel coated cell is then surrounded by a copper cylinder and flanges, insulated from the main body, as shown in Fig. 5, and this constitutes the water back for cooling the outer terminals of the elements. The illustration shows the water back with the outer cylindrical casing removed.

The standard form of generator adopted by Mr. Cox is shown in Fig. 6, which illustrates the five-lamp set, designed for lighting a house of moderate size. This set consists of four generators, 7 inches in diameter by 5 inches high. The

Fig. 7.—The Cox Laboratory, St. Albans, England.

interior of each generator is heated by a Bunsen flame rising through the central opening. The heat is deflected towards the sides of the elements by a series of discs which increase in diameter from the bottom upward. The deflectors become

[1] The Electrical Engineer, May 1, 1895.

red hot and serve to effect the complete combustion of the fuel supply. In the case of oil, these deflectors prevent the formation of soot and obviate the disagreeable odor of burning oil.

The standard capacity of the element adopted by Mr. Cox is 12½ watts, and instead of building generators of various sizes as was done in the early stages, the required capacity is obtained by coupling up a sufficient number of the standard elements. Thus one size of elements has an output of 5 amperes and 2½ volts on closed circuit; on open circuit the e. m. f. is 5 volts. This result is obtained with a consumption of 2½ cubic feet per hour of ordinary illuminating gas. With pure water gas a higher result is obtained, and with oil a still better result has been noted.

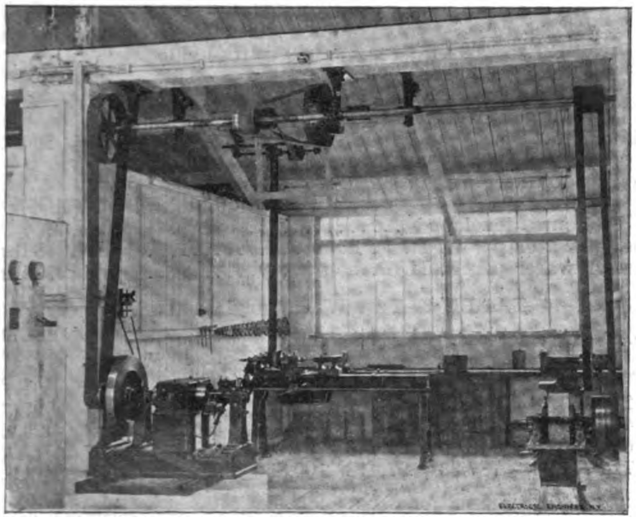


Fig. 8.—Machine Room, Cox Laboratory.

The generators are built, as stated above, to a standard size and coupled up like batteries. The voltage of the generators for different purposes can be varied from ½ to 12 volts by changing the form and size of the thermo-couples, the external dimensions of the element remaining the same. In the earlier types of his generators, Mr. Cox also employed a water back with continuous circulation of water. The circulation has been found to be unnecessary; all that is now required is the refilling with water of the back at intervals of about six months.

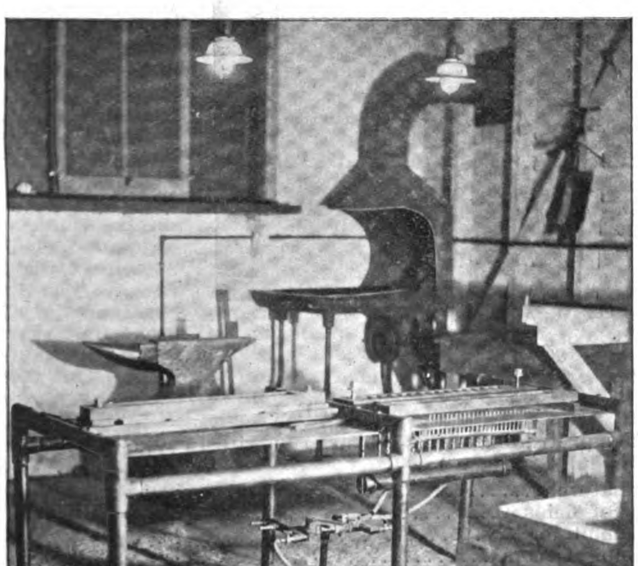


Fig. 9.—Moulding Department, Cox Laboratory.

The Cox laboratory, an exterior view of which is shown in Fig. 7, is admirably equipped for the economical manufacture of thermo-generators. Our illustrations, Figs. 8 and 9, represent, respectively, the machine and moulding rooms. One of the means for saving labor in handling is the overhead electric crane, illustrated in Fig. 10, the chief point of interest in connection with which is the fact that it is operated by current derived from thermo-generators. We believe that this is the first instance on record of apparatus of this kind driven by current generated in this manner.

At the St. Albans works the current generated in testing the thermo-generators is turned into a storage battery, a special switch being employed for the purpose. The battery is capable of giving 112 volts. Where the current demand is not continuous, as in house lighting, a storage battery is usually added to the thermo-generator equipment, the batteries being charged in parallel with the generators and discharged in series.

As regards the actual use to which the Cox thermo-generators have been put we may recall their employment as far back as two years ago in the office of the Commercial Cable Company, in New York, with excellent results and greatly increased economy over batteries. The generators have also been tested by the British Post Office electricians, who, we understand, were able to detect an increase of only .02 ohm in a 1-ohm generator, after six months' hard usage.

Mr. Cox is sanguine in the belief that with his generators any work of an isolated nature ranging from 1 to 2 horsepower, such as house lighting, the running of pumps, fans, small machinery, X-ray apparatus, etc., is feasible and economical. We understand that the English company is thriving and that an agency will soon be established in the United States. If Mr. Cox's statements are true, and we have no reason to doubt them, a large field awaits him in this country.

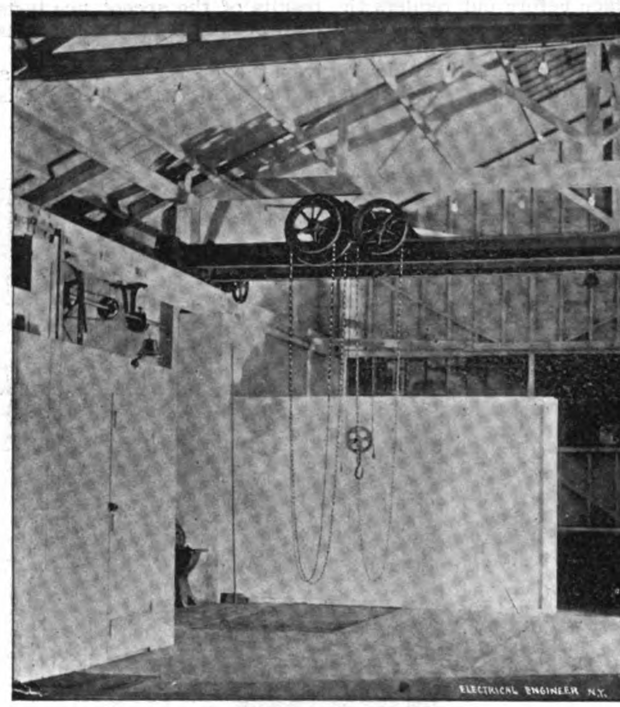


Fig. 10.—Electric Crane Driven by Thermo-Generated Current.

A Cox thermo-generator can be seen in operation at the offices of The Electrical Engineer, which will be gladly submitted to the inspection of those interested.

PHOTOGRAPHY UP TO DATE.

The following advertisement is clipped from the London (Eng.) "Standard" of Aug. 8: "The New Photography.—Owing to the success Mr. Henry Slater has personally achieved with the New Photography, he is prepared to introduce same in divorce matters free of charge. Offices, No. 1 Basinghall street, city." Mr. Slater, as a detective, is evidently up to date. We presume he uses the X-rays to discover the skeleton which every closet is said to contain. Ability to do the detective act without squinting through a keyhole is regarded evidently as one of the recommendations of the rays, which themselves prefer darkness rather than light.

THE HIGHEST POSSIBLE COMPLIMENT.

Mr. Harry Linwood Tyler writes us: "I enclose you check for The Electrical Engineer for another year. In stating that the publication is as interesting as ever, I believe that the highest possible compliment is paid you."

ELECTRIC LIGHTING.

TEST OF A 300 H. P. DE LAVAL STEAM TURBINE IN THE TWELFTH ST., NEW YORK, EDISON STATION.

THE New York Edison Electric Illuminating Co., whose stations and methods of working were described in extenso in our issue of Jan. 8, 1896, have always been in the vanguard of progress in the application of improved methods and devices, and as a result their new stations represent the highest types of modern electrical engineering. In the description of the company's work above referred to, mention was made of the fact that the Twelfth street station then in course of erection was to be operated by dynamos driven by De Laval steam turbines. This is the first instance of the use of this type of engine for regular commercial purposes in this country and hence the results obtained with it are not only of special interest to central station managers but to all power users as well.

Through the courtesy of the Edison Company we are enabled to place before our readers the results of the acceptance tests made on one of these turbines, two of which have been thus far installed.

The data marked Table 1 gives the operating data of a six-hour test under conditions of full load, while Table 2 is a résumé of some tests under partial load when operated with 2, 4, 6 and 7 steam jets, each test lasting one hour. The brake horse-power was obtained from the electrical horse-power by assuming that the commercial efficiency of the 100 kilowatt dynamos was 90 per cent.

Table 3 gives the temperature readings.

The 300 horse-power steam turbine on which these tests were made, which is illustrated in the accompanying engraving, was built by the Maison Bréguet, of Paris, for the Société de Laval. Each 300 horse-power turbine drives, by means of gearing, two 100 kilowatt Desroziers dynamos, one on each side of the turbine shaft. Operating with a steam pressure of 145 pounds to the square inch and a vacuum of 26 inches, the steam consumption, operating condensing, was to be not over 18.7 pounds per brake horse-power hour.

The turbine disc has a diameter of about 0.75 meter (29.5 inches) and a thickness through the blades of about 10 millimetres (.4 inches). The turbine disc runs at a speed of about 9,000 revolutions per minute; the dynamos at 750 revolutions per minute. The total equipment, comprising steam turbine, gearing and dynamos, occupies a space 4.05 meters (159 inches) long, 1.97 meters (77⅝ inches) wide, and 1.31 meters (51 inches) high.

TABLE 1—Full Load Test.

Average of readings:

+	+	—	—
127.25 volts.	692.48 amps.	128.26 volts.	709.18 amps.

127.25 × 692.48 = 88,118.080 watts + side
128.26 × 709.18 = 90,959.427 " – side

Avg. watts... 179,077.507 " both sides

179,077.507 is 90 per cent. of 198,975.01 watts = 266.72 h. p. × 6 = 1,600.32 h. p. hours.

Weight of water discharged from air pump, 6 hrs. = 27,763 lbs.

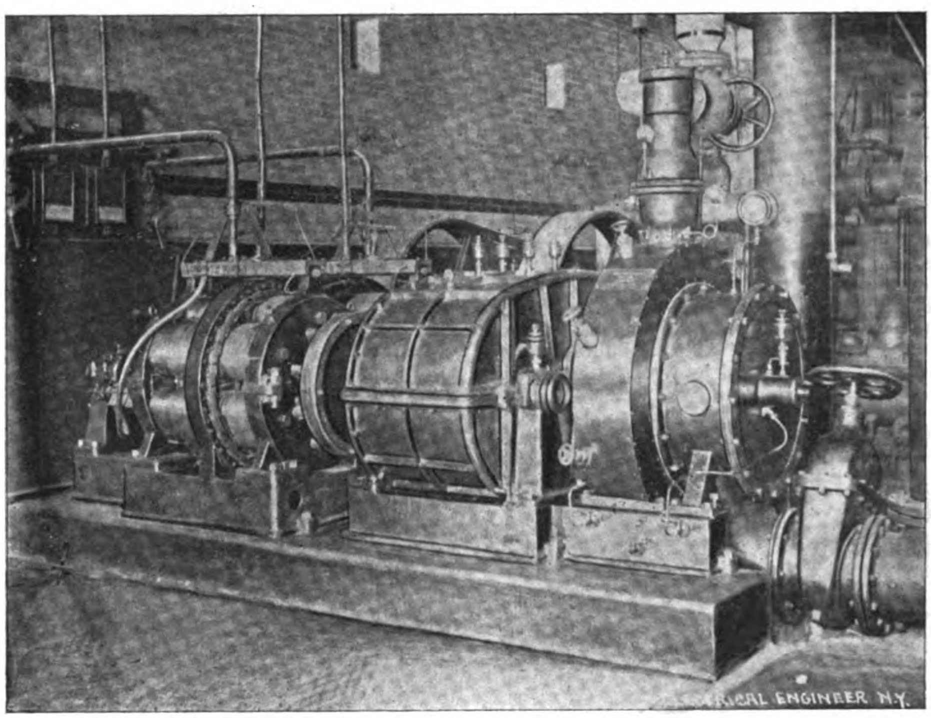
H. P. hours developed .... 6 hrs. = 1,600.32

Lbs. of water per B. H. P. hour .... 17.348 lbs.

Lbs. of water per E. H. P. hour .... 19,275 lbs.

TABLE 2—Test With Varying Load.

No. of jets used.	Average load. + Amps.	– Amps.	Average watts. +	–	Per cent. of full load.	Vacuum.	Lbs. of steam per B. H. P.
2	153.78	147.15	18.707	18.283	18.50	27.	27.35
4	433.60	455.80	54.156	57.886	56.02	26.43	20.22
6	700.85	718.65	87.746	91.268	89.51	26.07	19.75
7	771.94	787.33	97.418	100.856	99.14	25.79	19.95



300 H. P. DE LAVAL TURBINE IN NEW YORK EDISON STATION.

TABLE 3.

Temp. Readings after 6 hours run with Load as indicated.

	+ Dynamo.	— Dynamo.
Armature	120° F.	129°
Av. of fields	98°	107°
Commutator	144°	132°
Temp. of room	82°	
Temp. above room arm	38°	47°
Temp. above room fields	16°	25°

MR. H. S. JACOBS, the American mining engineer, has applied to the Mexican department of encouragement for the right to dam the Amacusac or Grande River, near its confluence with the Barranquillo, for the purpose of securing water power to operate his mill at Huautla, Jojutla District, State of Morelos and to generate electricity for transmission from the falls for use in Mexico City for power and lighting.

ELECTRIC TRANSPORTATION.

LONG DISTANCE AND HEAVY DUTY ELECTRIC RAILWAYS.[1]

BY F. W. DARLINGTON.

THIS subject may be treated at length from two standpoints, the scientific and commercial, either of which, to fully discuss, would take up more of your time than I feel justified in doing to-day. I will therefore occupy you with glances at both sides of the subject, and call your attention to a few of the important thoughts which I deem pertinent to the times, and of supreme interest to all of you who have roads, suburban, interurban, and local, to operate and earn dividends therefrom.

There are already in operation many long distance and also some heavy duty electric railways. The majority of these roads do not fairly come within the scope of this paper for the reason that they have been built as ordinary trolley roads, with road-beds insecure and unsafe for high speeds. Our subject refers more properly to roads designed to supplant the steam locomotive both for high speed and heavy freight service.

Some few roads have been built, which, though not longer than ten or twenty miles, and consequently not long distance roads, yet are convincing proofs of the ability of the electric motor to perform all work demanded of a steam locomotive. These roads have been installed as experiments and by such corporations as the P. R. R. Co.; the N. Y., N. H. & H. R. R.; and the B. & O. R. R.; and with all the success obtained on these, the corporations named are yet unconvinced of the advisability of adopting electricity for their entire systems.

This incredulity is not prejudice in favor of steam, as asserted by many writers, for the men at the helm of affairs in these big companies are too broad-minded and too alert for the companies' interests to be blinded by prejudice. Their slowness to be convinced is to be attributed more to the lack of proofs of its desirability from their point of view, as handlers of heavy traffic.

The first electric railway motors were designed to supplant horses in street railway work. And from this point the advances have been made by meeting and overcoming difficulties long since met and overcome by the steam railroadman. For it must not be forgotten that the first railroads were horse roads and when the steam locomotive was put upon them it had to undergo changes, and its use necessitated alterations in the construction of cars and roadbed. Does it not seem absurd, therefore, to ask steam railroad men to go backward some fifty years and begin over again, for this was the proposition advanced when they were asked to take hold of the subject in the shape it was only two years ago. It is to the method in which the question has been taken hold of by these men that is due the credit of the advanced position the electric motor holds to-day as a rival of the steam locomotive.

So far as the motor alone is concerned there is no longer a possibility of doubting its ability to do the work of a steam locomotive. It can make a car move as fast and faster. It can pull heavier loads by reason of its power being supplied from some exterior source, and hence, having practically an unlimited supply, it can climb steeper grades, and it can reduce expenses. Can more than this be asked of it? I think not!

There remains, however, the question of how to transmit the electricity from the stationary engine and boiler plant to the motor on the car. It has been proved beyond doubt that power can be developed in a stationary power house at a very large saving of coal and other expenses. Of this fact, and that of the ability of the motor to do all the work demanded of it, there is no difficulty in convincing the steam railroad man. But the inability to prove beyond a doubt that the power can be transmitted satisfactorily for long distances is where the failure lies. This is the one point to be worked out and demonstrated before there will be any general adoption of electricity for long distance roads.

There have been many theories advanced and systems proposed, but as yet but an insignificant number of them have been tried, and they only for very short distances.

This question must be solved, and all are looking for the solution in the alternating current system, but whether this or the direct current system is the solution is still an open question. There are many who think that the only solution is to come from the alternating current, but in the meantime devices are being added to the art that tend to making the direct current more and more of a success in overcoming long distance. Ultimately, no doubt, the ideal alternating current system will be at our service, and by the ideal system I mean that one requiring no actual current-carrying contact between the car and the track; in other words, some modification of the induction system. But unless this system is developed and made practical before long it will find the older direct current system so well established and so generally in use that it will be difficult to have it adopted except for new roads, for it must be borne in mind that the depression in the financial situation for the last two years is the reason more than any other that steam roads have not been changed to electricity. So that with the country enjoying even moderate prosperity there is sure to be extensive and widespread experiment in this line, and it is not too much to say that in five years' time there will be such a change in the minds of financial and railroad men that there will be a rush to obtain the benefits of the reduced operating expenses to be derived from using electricity.

This assertion may seem wild and romantic, but any close observer of the thought and the attention given this subject by the large steam railroad companies, will bear out this statement. It does not mean that people will go wild over it, for that period in electric railroad history is past, and all should be thankful for it. But it does mean that with money available there will be a general start to equip both long and short roads, and the start once made, the work will be pushed, on increasing numbers of roads, which, taken altogether, will constitute the equivalent of a rush.

The same conclusion is reached when it is remembered that the very conservatism of the steam railroad man, of which so much is said in electrical circles, will keep him and has kept him from adopting electricity until that same wonderful power shall have demonstrated its ability to do, and do continuously and satisfactorily, all of his work. This demonstration once having been made, and made in the manner those engineers abreast of the times are confident it will and can be made, that is, to prove beyond all possibility of doubting that money can be saved by discarding the steam locomotive for the electric motor—even when such change requires an enormous outlay of new money—then the conservatism must give way to progress, and all will be only too anxious to obtain the advantages to be gained.

What has all this to do with suburban and interurban railways as existing to-day? It is a question of vital interest to all those companies operating such roads. For all managers of local roads, whether they be running between towns or are purely local, if they in any measure parallel steam roads, have this fact staring them in the face, that it is only a matter of time, and a short time at that, before they will have real competition from those same roads whose territory they so profitably invaded.

They (the local managers) must know that a trunk line supplied with such power as it will require, can be tapped at any point to run a local road or branch line, at but small expense in comparison with that required to operate the local road independently. Then, too, let him think what it would mean to him to have a competing line with frequent service, and maintaining high speed on safe roadbeds.

All these things must be faced sooner or later, and while the above statement may seem alarming, yet it need not be so to the wise manager who will keep his eyes open and prepare himself in the time at his disposal.

Just what this preparation consists of will have to be worked out by each individual. But it is very safe to say here that one of the most important points he will have to consider will be that of expenses; he will have to reduce coal bills and bills all along the line. He will also have to guard well his policy of management, but as this point is not included in the scope of this paper it will not be elaborated upon, though there are interesting points for discussion which might be brought out.

The question of expenses is mentioned here for the reason it is safe to say that at least seventy-five per cent. of the electric railroads in this state are paying too much for their power. By power is meant available power at the car axle. Some develop power cheaply and waste it on the line; others may develop it at high cost while they distribute it, and utilize it economically; while others again may be losing at only the motor end of the line. Then again, some roads may be so full of heavy grades that they may be eating up their earnings in maintaining them.

At any rate, the fact remains that few, if any, are paying dividends, and many are in the hands of receivers, when it would be possible to make all pay, excepting, of course, those wildcat schemes floated to fleece people of their good dollars. The sooner these latter are weeded out or reorganized on a more reasonable basis, the better it will be for all. There is one thing very sure and that is that there is no excuse for any electric road, not saddled with interest for imaginary money

[1] A paper read at Altoona, Pa., before the Pennsylvania Street Railway Association, Sept. 2, 1896.

spent, to spend more in expenses (which includes salaries and interest) than its receipts amount to.

The reports obtained from many roads vary to such an extent that it is impossible to assume any given amount at any given place without knowing the conditions existing there. It might be stated here that a car mile should be produced for a given number of cents, based on these reports, and nothing of real value towards the solution of the question at hand would be gained, for all the calculations and reports made on power questions have been based on results at the power house, or at the switchboard, which is only a part of the proof, for they take no account of interest or line losses and motor repairs, which are all necessary for determining definitely as to the cost of a car mile. For of what use is it to calculate your power in kilowatt hours at the power house and in that calculation consider only your coal, water, supplies and labor, when you omit all account of your interest except as a lump sum? And of what use is it to define your motor repairs and car expenses in car miles when here, too, you lose sight of interest?

How can you tell how these several items compare unless you base them all on the same unit? This unit should be in car miles, for expenses of every description, and when they are so calculated you have the true basis, for all expenses are incurred for the one object of propelling cars a certain number of miles.

By this means the manager can determine the value of each department under him, and when economies must be undertaken he knows exactly where to turn to accomplish them. It would also enable the manager to tell at all times in what shape his engineering force was, whether his engineer was competent, and if he was attending to his duty. Again, he would be able to calculate to a nicety what each improvement would cost and in what way it would benefit him. His receipts, being readily reduced to earnings per car mile, would enable him at a glance to determine the prospects of his road.

All these points are of importance to know in order that the manager may keep himself posted as to the working of his system as a whole. The managers who do this are not many, and why they do not is to be attributed to the fact that the necessity for so doing has not been made clear to them. There are many who keep elaborate books with the expenses divided up into different classes, when they are principally only of value to keep the bookkeeper busy, and really do not enlighten anyone as to the scientific conditions of the road.

This association can broaden its scope of usefulness to its members and at the same time advance the interests of all electric roads by appointing a committee to gather data from its members and tabulating them, by numbers, not names, for it is not wise or of value to publish the names of roads making reports, and it is not necessary.

This committee can then digest the reports and each year draw impersonal conclusions for the benefit of all. This same method is employed by the National Electric Light Association, and though it has been in use only a few years it has proved a great benefit to those desiring to avail themselves of its lessons.

It will be well to return once more to the subject of grades and curves, to say that both are expensive luxuries, not only because they cost more to maintain than straight level roads, but also because they are more expensive to operate, and are the cause of greater original investment. And as we have seen in the case of the Columbia & Donegal R. R., they may be the source of many and expensive damage suits.

Suppose A and B each build a road from X to Y, and A builds his with long radius curves and as little grade as possible, say a maximum of 1 per cent., while B does not appreciate the gain in this method and so has some heavy curves and some heavy grades. What will be the result? It is well known that it takes more power to climb the hill than to run on a level, but you say that the motor on the level averages the same power for the whole round trip. That is true, but here is the point, for A can do his work with smaller motors which will be running more continuously and will be calling for a more even supply of power from the power house, which in itself will be a source of economy both at the motor and at the power house. B will be drawing power intermittently and creeping up the hills to rush down the other side at great risk. B's motors will cost more than A's because of their larger size, and B's engines and generators will have to be larger. His feeders must be larger. Just what these several items will amount to can be determined, and I maintain that they should be calculated before a road is built, and the economical grades figured out.

When it comes to competing with the steam roads as they exist to-day, the electric road attracts local travel because of its cars being run at frequent and regular intervals, whereas a traveler must consult a time-table before taking a train on a steam road. Again, in summer time the electric road offers the additional inducement of a cool, clean ride, while on the steam road if one opens the window for fresh air he is treated to a shower of coal dirt, cinders, and dust, to such an extent that when the journey is over the passenger is more uncomfortable than when he started.

All this is destined to change, however, for the undoubted tendency of steam railroad travel between large cities is to move trains at more regular and more frequent intervals. This is indicated by time-table records for some years back. The clean travel will come when electricity is adopted.

The question of the real meaning of the difference in number of trains running on competing roads is shown very clearly on the roads operating between Philadelphia and New York. Of these two roads the Pennsylvania gives by far the most trains and the result is that it gets the most of the travel. This is natural for the reason that a man bound to New York from Philadelphia will buy his ticket by the route that will give him the greatest choice of times to start on his return. Carrying the comparison farther, suppose an electric road was built between the two cities and built so that it could land pasengers in New York as quickly as the steam roads and a train service every fifteen minutes or a half hour be maintained, there is no doubt that it would get the bulk of the travel.

As for speed, if a speed of seventy-two miles an hour can be obtained on a road seven miles long and maintained for three miles, as has been done on the electric road installed by P. R. R. Co., in New Jersey, it certainly would be no more difficult to obtain a speed of eighty to ninety miles an hour on such a roadbed as possessed by the P. R. R. on its Philadelphia-New York line. As for the length and weight of train, the same road has demonstrated that it can handle a train of three cars, i. e., motor car and two regular Pennsylvania day coaches as trailers and fulfill its schedule requirements.

I have observed with interest the fact that the majority of trains leaving the Broad Street Station, Philadelphia, are composed of a combination car and two or three trailers and that trains of more than four trailers are not frequent. It therefore seems to indicate that a motor car of sufficient capacity to draw these trailers at the desired speed could be made a standard and do all the work. This might necessitate making two sections of the through trains, but this would prove a benefit to the traveler, especially if the two trains were scheduled to run at different times.

Right here it might be interesting to consider what we are to have in the place of the steam locomotive. It can be demonstrated conclusively that when we discard the steam locomotive, the most economical and convenient method will be to put the motor under a baggage or combination car, for if we attempt to follow steam railroad practice and carry enough weight on an electric locomotive to provide traction for a train, we will have to add useless weight, and one of the chief sources of economy of the electric system over the steam is from the reduction of the weight of train. The weight can be done away with because of the fact that the even pull, at a tangent to the circumference of the motor armature, produces an apparently greater possible traction effort per ton of weight, and in addition reduces the tendency of the wheels to slip at starting.

This feature of the electric motor is the one above all others that establishes the fact that it has come to stay, no matter what developments may be made in air, gas, or other motors which have to convert a reciprocating into a rotating motion.

And the fact that an electric motor supplied directly from a central power house gives to that motor a practically unlimited supply to draw from, puts it far ahead of any motor which carries its supplies on its back, whether it be in air tanks, storage batteries, oil reservoirs, or coal and water bunkers. Any storage reservoir must be refilled and this takes time. And all time used in this way is dead loss and means that the motor can not make as many miles in a day.

One more point in favor of the electric motor is that where they are equipped with double motors and two controllers, there is no one thing that can happen to prevent the motorman from getting his train to its terminus, for with the modern apparatus he can cut out the motor or line giving trouble and proceed with one motor. To be sure his speed will be decreased, but still he will be able to move his train, whereas in any of the above cases there are a number of accidents, and trivial ones, that may happen to cause the train to wait for a new motor. Of course, the question of the supply line, or feeder system, is ignored in this statement; but with the advent of electricity on steam roads, will undoubtedly come a feeder system practically impossible to interrupt.

The question arises when considering cars for high speed work as to what kind of motor trucks should be used.

The advocates of maximum traction trucks refer to the steam locomotive as their model, but there are some principles in use on the steam roads which we must avoid, and this is

one. The steam locomotive is of necessity a maximum traction machine, but it has been demonstrated that a car can be started and propelled with less power when the trucks have a motor on each axle (i. e., four motors on an eight-wheeled car), than where equipped with a motor on each pair of axles (i. e., two motors to an eight-wheeled car), and this too when the four motors are of greater weight than the two larger motors.

These so-called maximum traction trucks with one pair of small wheels are lately provided with some kind of device to hold down the small wheels to keep them from jumping the track. This deprives the truck of most of the efficient traction obtained by putting the weight nearer the axle of the larger wheels, so that the results obtained are practically no better than were the light wheels made the same size as those carrying the motor and the weight of the car placed centrally over the truck.

It will be noticed, too, that a maximum traction truck rides more roughly than a regular truck; this for the reason that the car support is placed more over one axle than the other and thus gets practically the same hammer motion that the motor does and does not get the relief given by equalizing and dividing the motion of both axles as found on regular trucks. In this question of trucks as we approach nearer the practice of steam roads in other respects, we will find it to our advantage to be guided by their experience and not attempt to drag with us the crude ideas heretofore held. It is only just to say here that most builders of trucks have recognized this point since the building of these roads mentioned at the beginning of the paper, and have been trying to educate their customers to this belief, and with some measure of success.

In closing, I will remind you that the era of long distance, high speed and heavy duty electric railways is at hand. The first experiments have been made and steam railroad men are awake to the facts. And those of you having roads that must come in competition with them must bear in mind that the steam railroad man will bring to the subject an experience of great value and that there are certain matters in connection with your roads that will bear your closest inspection, such as power house, distributing system, motor repairs, track, grades and trucks.

I have only outlined the bearing of these subjects on your work on account of the limited time at my disposal.

BALTIMORE'S LAST HORSE CAR TO GO.

The last horse car in service in Baltimore will soon make its final trip. This car runs on Ann street, between Band and Thames, on a track of the Baltimore City Passenger Railway Company, and only on market days during market hours. Col Walter S. Franklin, president of the road, says that a contract has been made with Mr. Frank H. Sloane, electrical engineer, to make it an electric line.

MR. C. D. HOTCHKISS has been elected vice-president of the Chicago North Shore Electric Railway Company, succeeding J. E. Montrose, resigned.

THE HARDIE COMPRESSED AIR STREET CAR MOTORS IN NEW YORK.

DURING the past two months a number of compressed air locomotives have been in operation on the 125th street cross-town line of the Third Avenue Railway Company, and numerous articles have appeared in the daily press dilating upon the great benefits to the public and the saving to the railway company which would accrue by the equipment of the entire line with these motors, and hints have been thrown out that it was but a question of a short time when the Third Avenue Railroad would adopt the system and abandon its present system of propulsion by cable. At about the time these cars first went into operation one of our contributors, Mr. Robert Lundell, showed by a critical analysis the fallacy of assuming that economy could be obtained by this method of propulsion, as compared with electricity, and thus far no figures of actual tests of the cars in operation have been forthcoming to indicate that the compressed air motor cars give the economy claimed for them by the company operating them. It may be well to state here also that the compressed air cars running on 125th street are operated entirely at the expense and risk of the American Air Power Company. The Third Avenue Railroad Company has assumed no responsibility whatever for their operation, it has not indorsed the system, and it has no data before it yet upon which to base any opinion whatever of the practicability of the system for the whole, or any part of its railroad system; and so far as the Third Avenue Company's changing its system over from cable to compressed air, as has been hinted at in some quarters, the statement is characterized by officers of the company as absurd in the present stage of affairs.

FIG. 1.—HARDIE COMPRESSED AIR MOTOR.

Before entering into a description of the plant, it may be stated that the compressed air motor cars are operated on a practically straight and level road, from the Fort Lee ferry on the Hudson River to the foot of 125th street and the East River. The conditions therefore are in a sense ideal. As for the compressed air motor cars attempting to climb the grade on Amsterdam avenue, that has so far only been done once, in an experimental trip, successful but not conclusive.

The plant for furnishing compressed air to the motor cars consists of two compound Norwalk 75 horse-power compressers, working under a steam pressure of 140 pounds, compressing the air to 2,250 pounds to the square inch. The compressed air is stored in a reservoir consisting of 30 Mannesmann steel tubes, Fig. 2, 20 feet long by 8 inches inside diameter, and ⅝ths of an inch thick. The capacity of these tubes at 2,250 pounds is about 31,500 cubic feet. Trouble was at first experienced in the packing of the connections, but this was overcome by using red fiber washers. From these storage cylinders the air cylinders on the car are filled, each car having a capacity for taking one-fifth the capacity of the station reservoir, that is, about 6,000 cubic feet at 2,250 pounds pressure. The time required to charge a car is 6½ minutes.

The compressed air is admitted to the cylinders of the car

engine, which are 6 inches in diameter, with a stroke of 16 inches, the pressure being reduced from 2,250 to 150 pounds to the square inch. The air in passing from the air cylinders on the car to the working cylinder on the engine is heated to 350 degrees Fahrenheit. This is done in order to prevent freezing and the formation of ice in the working cylinder, and valves and at the same time effects an economy in reducing the volume of air required. Each car is calculated to make a run of sixteen miles with a single charge. The engine on the car,

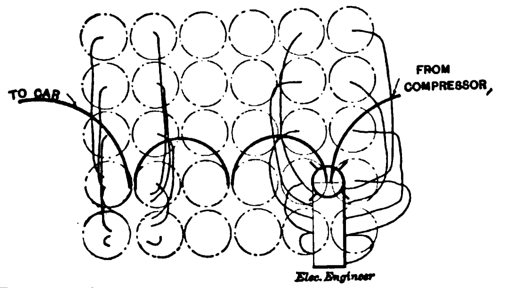


FIG. 2.—ARRANGEMENT OF COMPRESSED AIR TANKS.

which is illustrated diagrammatically in Fig. 3, is patterned after the usual steam engine with an oscillating crank, but is deprived to a certain extent of the power of using the compressed air expansively, and the air is admitted for the full stroke of the cylinder. The result is that the cars now are recharged after each trip of four miles.

The weight of the car complete is 18,000 pounds. Of this, 6,000 pounds is chargeable to the car body, 500 pounds to hot water for heating the air, 500 pounds to the compressed air stored in the tanks, and the remainder to the truck, motive equipment and air cylinders.

There are no less than four levers required to control the car. One handle operates the main air valve which admits the air to the engine cylinders and controls the speed. A second

inder so as to accelerate the starting of the car. A fourth handle acts to cut-off entirely the supply of air from the tank. At the end of each trip the motorman removes all four handles and transfers them to the other end of the car to corresponding positions.

The car which is illustrated in our engraving, Fig. 1, taken from "Compressed Air," is 28 feet long over all, with a 20-foot car body, and 4-foot platforms. Its seating capacity is 28 persons.

As to the operation of the cars themselves, it may be said that starting and stopping are not accomplished as smoothly or

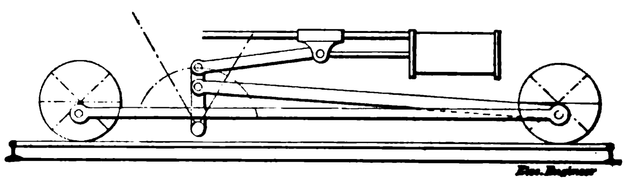


FIG. 3.—DRIVING GEAR OF COMPRESSED AIR ENGINE ON CAR.

as well as is the case with cable and electric cars. In fact, a dead stop cannot be made at all, and in case of emergency it has been demonstrated that the cars cannot be stopped within ten feet, while with electric and cable cars almost a dead stop can be made within a distance of five feet.

THE RIKER ELECTRIC VEHICLE.

WE illustrate herewith the electric vehicle, for pleasure purposes, designed recently by Mr. A. L. Riker, and built by the Riker Electric Motor Company, of Brooklyn, N. Y. It has been entered for the "motorcycle" races at Providence, and whatever be its success it must be allowed to have many noteworthy features of merit. It weighs 1,500 pounds, and can be fitted with extra batteries when needed, bringing

RIKER'S ELECTRIC CARRIAGE FOR FOUR PERSONS.

handle operates the reversing gear and controls the cut-off by operating the link motion. A third handle controls the air brake. By throwing this same lever over to another position, air at higher pressure than normal can be admitted to the cylinder so as to accelerate the starting of the car.

its weight up to about 1,800 pounds. It will carry four passengers, two fronting ahead and two astern. The body of the vehicle is black, the wheels and gear are a bright, cheerful red. The wheels are of the bicycle type ,with stout wire spokes, and

pneumatic tires, and were furnished by the Crawford Wheel and Gear Company, of Hagerstown, Md. The under shafting that carries the body is built of tubular steel. Two Riker motors of 3 horse-power each and weighing 180 pounds each, are mounted so as to gear each side upon the gear wheels on the rear axle, and in this way motion is imparted. The motors are ironclad and are very tightly inclosed so as to insure protection against dirt or damage. The pinions and gear wheels are also protected. The rate of reduction of the speed of the motor is 5 to 1. There is a strap brake, operated from the front seat, the use of which on a band wheel on the motor shaft obviates the necessity of applying a brake to the wheels themselves.

The carriage is steered by a tiller projecting from the dashboard towards the riders, and so contrived as to work with a right and left motion. The wheels are pivoted at the hub and are locked in position in an instant by pressing down on the tiller. Four speeds are obtainable by the corresponding four dispositions of the storage batteries that supply the current. The changes are effected by means of the small handwheel at the side of the carriage within easy reach of the driver. This wheel is on the shaft of a controller placed horizontally under the front seat, and the successive steps are like those with a street car controller. The speeds are 5, 10, 18 and 25 miles an hour. The wheel is turned forward for forward motion of the vehicle and reversed for a backward motion.

Current is obtained from 32 cells of a special make of chloride accumulator furnished by the Electric Storage Battery Company, of Philadelphia, each giving 100 ampere hours. The weight is about 800 pounds, and the batteries are inclosed in boxes so as to prevent spilling of the acid. On the average road the batteries will furnish power enough to run the carriage not far short of 50 miles at 10 miles an hour. They also furnish current for an electric gong and for two strong lights of the usual carriage lamp character.

The carriage is admirably contrived and balanced, and while light to look at moves with wonderful steadiness. It turns easily, moves forward or backward at a touch, and by having two motors is able to get along very well even if one of them should break down. The battery is also arranged in such a way that sections can be wholly cut out if desirable. Altogether, one has only to see this vehicle run, and to watch its smooth, swift motion, or to enjoy a ride on it, to become convinced that a great future awaits carriages of this class, not only for pleasure, but for all the innumerable uses of trade and intercommunication. Mr. Riker does not hesitate to say that he looks forward to the early development of a great electrical industry in this field.

SOCIETY AND CLUB NOTES.

FIFTH ANNUAL CONVENTION OF THE PENNSYLVANIA STREET RAILWAY ASSOCIATION.

The fifth annual convention of the Pennsylvania Street Railway Association met in the theatre at Lakemont, Altoona, Pa., on Sept. 2. Mr. John Lloyd, of Altoona, introduced Hon. Martin Bell, who made the address of welcome. Hon. B. F. Meyers, president of the Wilkesbarre and Wyoming Valley Traction Company, responded. Both addresses were entertaining and interesting and were heard with great attention.

Following this, papers were read on "Long Distance and Heavy Duty Electric Railways,"[1] by Mr. F. W. Darlington; "Construction and Maintenance of Electric Railway Tracks," by Mr. George H. Neilson; "Transfer Tickets," by Mr. J. H. Stedman; "Street Railway Law," and "Liability Insurance" were the topics next introduced for general discussion. Addresses on these subjects were made by E. C. Felton, of Harrisburg; G. S. Larzelier, of Norristown; E. H. Davis, of Williamsport; and President B. F. Meyers, of Harrisburg.

A committee of five was appointed by the chair to take charge of the matter of new legislation on the subject of street railway corporations. This committee is composed of E. C. Felton, of Harrisburg; E. H. Davis, of Williamsport; Richard Koch, of Pottsville; G. S. Larzelier, of Norristown; B. F. Meyers, of Harisburg; and John Lloyd, of Altoona.

At the afternoon session the discussions on "Street Railway Law" and "Liability Insurance" were again taken up and continued at some length, after which the annual election of officers took place as follows: President, John Lloyd, of Altoona, first vice-president, Albert Johnston, of Allentown; second vice-president, Robert Wright, of Allentown; secretary, S. P. Leight, of Lebanon; treasurer, W. H. Lanius, of York; executive committee, John Lloyd, B. F. Meyers, S. P. Leight, John A. Rigg and E. C. Felton.

[1] See page 255, this issue.

Allentown was selected as the next place of annual meeting. A vote of thanks was tendered the local traction companies for courtesies extended, and to the officers of the association for the thorough manner in which they had attended to their respective duties.

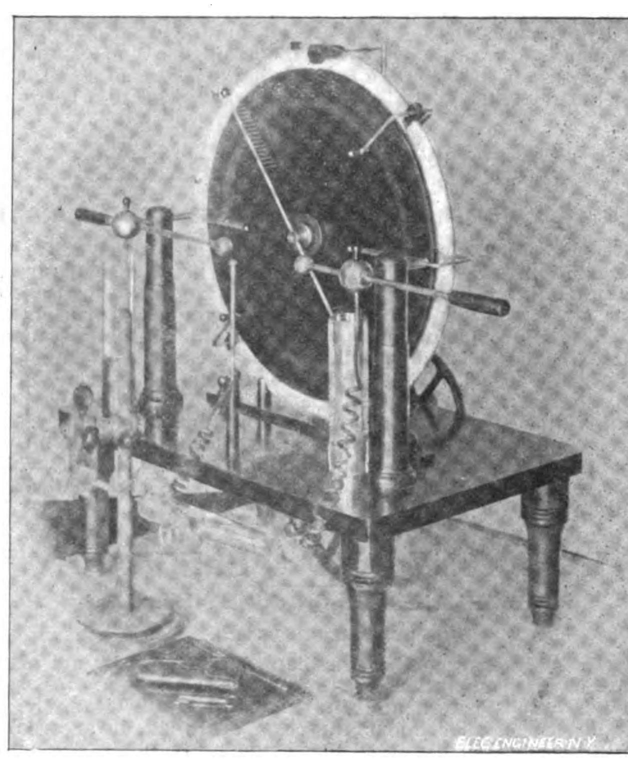
The following programme was observed on Sept. 3: Visit to the electrical department of the Pennsylvania Railroad shops; excursion to Wopsononock, train leaving Juniata at 9.30 a. m.; trolley ride over lines of the Altoona and Logan Valley Electric Railway Company; banquet, Mountain House, Cresson.

The new Edison electric light plant in Altoona, lately extended and remodeled, was visited also by the delegates on Sept. 2, under the escort of Mr. E. B. Greene, the general manager and electrical engineer.

ROENTGEN RAYS.

THE PRACTICABILITY OF THE STATIC MACHINE FOR X-RAY WORK.

THE first X-ray experiments on record were made with a Ruhmkorff coil and naturally other experimenters used coils. It was found that the larger the coil the better the results, but at present the general opinion of those having practical experience seems to be that coils of 8-inch or 10-inch spark length give fully as satisfactory results as larger ones. The time of exposure is not enough shortened nor are the



FREI STATIC MACHINE FOR X-RAY WORK.

details brought out so much better as to justify the expense of very large coils.

Only a few of the large number of experimenters looked upon the static machine as a substitute for the more expensive coil; some met with success, others failed. The failures were due mostly to one of three causes:

1. The machines being of the school type, pretty enough to look upon but flimsily constructed, could only be run a few minutes at a time without a breakdown.
2. The machines were too small or run too slowly to give the required spark length or rapidity of discharge.
3. The operators did not use them properly.

Those that succeeded found that a machine of given spark length will do better work than a coil of the same spark length and that the definitions obtained with the static ma-

chine, both the Wimshurst and the Toepler-Holtz, are much clearer and that the tubes lasted much longer.

Messrs. Frei & Co., of Boston, recognized the importance of the static machine for X-ray work and have placed upon the market a Toepler-Holtz machine which, neat in design, combines strength and durability with a low price. The No. 2, or double plate machine, answers all requirements of the average surgeon. The stationary plates are of glass, 20 inches diameter and the revolving plates 17 inches diameter, are of hard rubber especially vulcanized for the purpose. The latter are mounted upon ball bearings and can be revolved at a speed of nearly 2,000 revolutions per minute, the ratio of transmission being 1:18. All the metal parts are nickel plated and the whole is mounted upon a mahogany base. A mahogany case with glass front is furnished with each machine. While it cannot be denied that the average static machine is influenced by the weather, this can easily be overcome by keeping the machine in a case and by placing a dish of calcic chloride or other absorbing agent within the case. At any rate this new machine has never been known to fail in any kind of weather when treated in this way. To make the machine completely independent of the atmospheric conditions the manufacturers are experimenting now with a special drying apparatus to be attached to the base of the machine. One of the most important parts of this machine is the spark gap post which is placed half way between the dischargers so that it can be used from either rod as may be found convenient. One terminal of the tube is connected to one of the discharging rods and the other terminal to the spark gap; the distance between the second discharging rod and the spark gap post is then regulated to suit the requirements of the tube.

To those who will make an unprejudiced comparison between the static machine and the Ruhmkorff coil it must be obvious that the former has a number of points in its favor. There is no danger of its ever burning out; a burned-out coil is practically a complete loss. There are no running expenses; even if the machine is run by a power motor of one kind or another the expense is smaller than the running expenses of a coil; and, last but not least, there is its comparatively low first cost.

REPORTS OF COMPANIES.

RECEIVER FOR THE KINGS COUNTY ELEVATED ROAD.

General James Jourdan has been appointed receiver for the Kings County Elevated Railroad, Brooklyn. The company has defaulted interest on its bonds, owes the city taxes for three or four years, and has found it difficult to get coal to run its engines, unless paid for in spot cash. In 1892-3 the passengers numbered 50,000 a day, but the past year the average has been only 40,000. The total receipts last year were $767,338, against $564,074 total expenditures. The failure of the road is broadly attributed to the competition of the trolley. The receiver is one of the heaviest stockholders in the company. The total indebtedness reaches about $12,000,000, of which nearly the whole is in various forms of bond and bonded liability.

TELEPHONY AND TELEGRAPHY.

CABLE LANDINGS ON CONEY ISLAND.[1]

BY JAMES R. BEARD.

A FEW years ago the Brazilian Government by act of its Parliament authorized the purchase of the cables operated by the Western and Brazilian Telegraph Company, an English corporation, along the coast of Brazil, in accordance with the concession granted that company in 1873. The act of Parliament provided that the income derived from the operation of the cables, when purchased by the Brazilian Government, should be used to pay the interest on the cost of purchase and provide a sinking fund to retire the bonds issued for such purpose. It was expected that the Brazilian Government would have no difficulty in floating a loan on this basis, but just at the time Brazil proposed to negotiate this loan, the English cable managers caused the English Government to seize the island of Trinidad with the apparent intention of using it for the establishment of a rival submarine cable to be laid in two sections between Buenos Ayres and the island of St. Vincent, now connected by cable with England.

The island of Trinidad was practically a telegraph post in mid-ocean so conveniently placed that it divided this proposed rival cable into two sections of about 1,800 miles each. Were it not for Trinidad, a cable 3,600 miles in length would have been necessary, and its cost would have been too great. So you see the island of Trinidad was used as a scarecrow to defeat the proposed loan of the Brazilian Government and served to continue the English monopoly of cables on the coast of Brazil.

Practically the same thing has been done on our shores within the past few months. A foreign cable company has landed a cable on the coast of Coney Island without even asking permission from the United States Government. This cable is to connect with a French cable which has a monopoly to connect the West India Islands and the northern coast of Brazil. It is currently reported that our Government officials hold to the opinion that there is no law to prohibit foreigners from landing cables on the shores of the United States.

It has always been understood that the marine league was for national defence. A submarine cable in the hands of foreigners, silent and secret in its operation, is certainly as dangerous as a battery built by foreigners within that marine league. This marine league has been invaded by a foreign cable company, and it seems strange that no action has been taken by our Government.

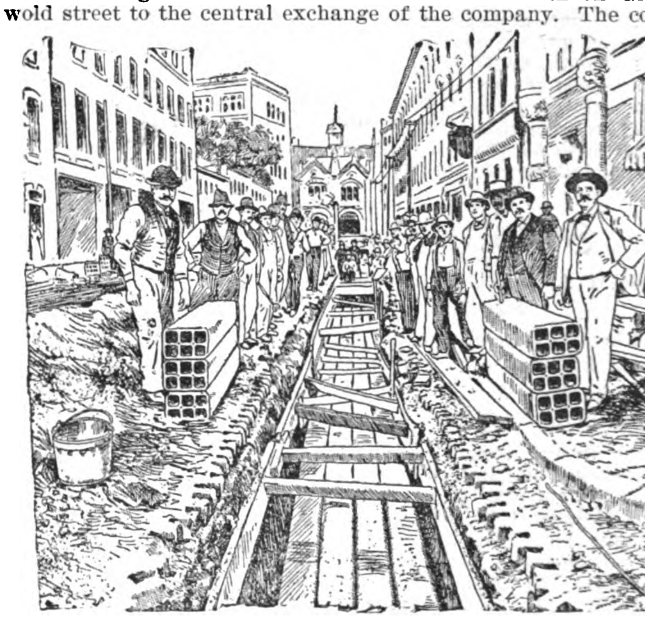
The courageous action of Brazil in obliging the Englishmen to surrender the island of Trinidad is a good object lesson for our Washington officials. Undoubtedly the executive has full power, in the absence of Congress, to prevent such invasion of the coast of the United States by foreigners. Certainly the executive has police power in this matter under the constitution, which also provides for the regulation of commerce with foreign countries, the courts of the United States having decided that telegraphy is commerce.

[1] New York "Sun."

UNDERGROUND CONDUCTORS AND CONDUIT OF THE DETROIT TELEPHONE COMPANY.

IN our last issue we gave some details in regard to the extensive work now being done by the Detroit Telephone Company, of Detroit, Mich. This is one of the largest of the companies organized in opposition to the old Bell system, and is spending nearly $500,000 on its plant, in order to serve the 5,000 subscribers which it is understood to have enrolled.

We now give a view of the work being done by the company on its underground wires. The illustration shows the conduit being laid from Grand River avenue north on Griswold street to the central exchange of the company. The con-



LAYING McROY TERRA COTTA TELEPHONE CONDUIT IN DETROIT.

duit used is that of Mr. J. T. McRoy, of Chicago, and is of vitrified terra cotta which has abundantly proved its value in electrical subway construction. This conduit is made up in 2, 3, 4, 6 and 9 duct sections, and in the cut the 6 duct type is seen. Into this conduit cable made by the Standard Underground Cable Company is being drawn.

The underground cable for the Detroit Telephone Company, ordered so far from the Standard Underground Cable Company, consists of 80,000 feet of Standard double wrapped dry paper, lead covered, 50 and 100 pairs, No. 19 B. & S. G. This quantity is already in hand and about as much more will follow.

The American Bell telephone instrument statement for the month ended August 20 shows a gross output of 9,675, against 11,009 in 1895. Returned, 7,856, against 8,730; net output, 1,825, against 2,279.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Currents:

CHANGING FREQUENCY. By Ludwig Gutmann. Description of a method for changing the frequency after transmission. "Elec. Eng'r," Sept. 2, '96.

Electro-Chemistry:

ELECTRICITY IN METALLURGY. By W. Borchers. The importance of electricity for direct working of metals at high temperatures and in connection with prěliminary preparation of the ores before melting is pointed out. The various processes for reducing and separating metals are presented in tabular form.—"Zeitschr. fur Elektrochemie," Vol. II., p. 368, in abstract. Lond. "Elec. Rev.," Aug. 21, '96.

Isolated Plants:

ELECTRICAL PLANT OF DUQUESNE STEEL WORKS AND BLAST FURNACES. Details of power house, generators, switchboard, pumps, cranes, etc. Two 500 horse-power, 250 volt, direct current generators, and six 60 light arc dynamos; six 50 horse-power shunt motors and one 45 kilowatt single-phase alternator form the electrical outfit of the plant.—"Elec. Eng'r," Sept. 2, '96.

Lighting:

MANCHESTER LIGHTING REGULATIONS. A revision of supply of current regulations was required owing to the departure of using 200 volt supply in certain districts with a three wire system having 400 volts between the two outside wires.—Principle clauses to be found in Lond. "Elec. Eng'r," Aug. 21, '96.

LIGHTING OF RAILWAY TRAINS. By Carl Kriz. After tracing the historical development of railway train illumination and presenting statistics of the number of oil, gas and electric lamps used on one of the Australian roads, author gives the following results:

The total cost per lamp hour per candle power was, for

Oil lamps consuming........	.02 kg. per hour,	3 c. p. =	.0016c.
Oil gas "	.2 c. m. "	4 c. p. =	.00125c.
Regen oil gas "	.023 c. m.	6 c. p. =	.00096c.
" (2 flames) consuming	.03 c. m. "	9 c. p. =	.00083c.
Incandescent lamp, 23.5 volts,	2.5 watts, per	6 c. p. =	.00120c.

—"Zeitschr. für Beleuchtungswesen," Aug. 20, '96.

LIGHT OF THE FUTURE. By E. Hospitalier. In a short article author gives the following figures relative to the quantities of heat given off by combustion of gas in different burners, and also by acetylene and electric lamps:

Gas candle	413	B. T. U. per c. hour.
Flat flame burner..................	252	
Bengel "	206	
Welsbach "	41	
Denayrouze "	20	
Acetylene "	31	
Incandescent lamps (not pushed)....	11	
Incandescent lamps (pushed)........	8	
Ordinary 10 amp. arc...............	2	

—"Progr. Age," Sept. 1, '96.

Power Transmission:

COTTONWOOD POWER TRANSMISSION, UTAH.—Detailed description of plant with illustrations. Generating plant consists of four 450 kilowatt three-phase 60 cycle generators separately excited connected to 60-inch Pelton wheels. The line is over seventeen miles long and has an efficiency of over 68 per cent.—"Elec. Eng'r," Sept. 2, '96.

Railways:

BEHR'S HIGH SPEED RAILWAY. The single railroad mentioned in Synopsis, Aug. 26, is referred to and the points claimed by Mr. Behr to be an improvement on the system are enumerated.—"Elec. Eng'r.," Sept. 2, '96.

TWO HUNDRED HORSE-POWER LOCOMOTIVES. The Westinghouse-Baldwin Locomotive Works have completed this large mining locomotive. Detailed items of sizes are presented in "Elec. Eng'r," Sept. 2, '96.

MUNSON ELECTRIC CONDUIT RAILWAY. Two diagrams illustrating this system with a short description appeared in "Elec. Eng'r," Sept. 2, '96.

ELECTRIC RAILWAY SYSTEM OF THE NORTHERN COAST OF NEW JERSEY. Description of the two recently built electric railways connecting the seaside resorts on the northern portion of the New Jersey coast line. Total length 24 miles measured as single track. Seventy pound 4½ inch T rails. Tandem compound direct connected engines and 400 kilowatt Westinghouse generators. Three batteries of boilers, two of 325 horse-power each, and one of 250 horse-power.—"Street R'way Journ.," Sept., '96.

ELECTRIC RAILWAY OF ROME, ITALY. The line purchases its current by meter from the sub-station of the Tivoli-Rome Transmission plant. In addition to the transformers used for lighting purposes, a set has also been installed in which the alternating current is transformed down to 400 volts. At this pressure it enters the collector rings of a number of rotary converters, and issues from the commutator side, direct current at about 550 volts. The equipment of the sub-station is completed by an extensive battery of Tudor accumulators, 304 in number, with a capacity of 1,000 ampere hours. This is in parallel with the trolley circuit and is divided into line groups of 26 cells each. For further details see "Street R'way Journal," Sept., '96.

STREET RAILWAY OF HANOVER. By C. O. Mailloux. Short description of this combined battery and overhead line. Equipment consists of three water tube safety boilers of 175 horse-power each, 145 pounds pressure; two horizontal compound engines, 200 horse-power each operating the generators. —"Street R'way Journ.," Sept., '96.

ORGANIZATION AND OPERATING METHODS OF THE METROPOLITAN STREET RAILWAY COMPANY OF NEW YORK.—This article gives the history of the company, details of organization, working force, general traffic conditions, how traffic is handled, transfer system and statistics. Four hundred and twenty-five cable cars and 35 electric cars are in regular and special operation over the entire 32 miles of trackage, cars being thus spaced at an average distance of 365 feet at maximum service.—"St. R'wy Journ.," Sept., '96.

GROWTH OF ELECTRIC RAILWAYS IN SOUTHERN NEW ENGLAND.—Some abstracts of the statutes of the various States, showing the conservative lines on which roads must be constructed and managed. Also the following statistics of street railways in Massachusetts, Rhode Island and Connecticut:

	Mass.	R. I.	Conn.
Number of miles operated.	1,087	143	317
Number of cars operated...	4,426	636	896
Passengers carried	259,794,308	32,618,473	38,037,474
" per capita.	112	94	50
Gross receipts	$13,246,372	$1,624,281	$2,232,051

—"Stret R'way Journ.," Sept., '96.

Roentgen Rays:

REGULAR OR SPECULAR REFLECTION OF THE ROENTGEN RAYS FROM POLISHED METALLIC SURFACES. By O. N. Rood. A series of carefully prepared experiments show that metallic surfaces which are highly polished for ordinary light are only imperfectly polished for the X-rays, and all the experiments detailed in this paper are in harmony with the idea that X-rays consist of transverse waves like those that constitute ordinary light, differing from them only in being shorter.—"Am. Journ. of Science." Sep. '96.

PERSONAL.

MR. J. MIYAKE, a graduate of the Engineering College of Japan, is at present in this country studying electrical plants and methods. He comes with letters of introduction from Mr. Fujioka, the well-known electrical engineer at Tokio.

MR. A. DAVIDSON, late electrician on the steamship Minia, has been appointed assistant cable engineer to the Central and South American Telegraph Company, with headquarters at Lima, Peru. He left Monday, the 31st, to take up his duties.

Mr. F. B. COOK has resigned the position of Chief Engineer of the Central Union Telephone Company after seventeen years connection with that corporation; during this time he has filled probably every technical position in the company's service. Mr. Cook's experience in the telephonic field has been of a wide scope, and many of the telephonic labor-saving devices in use in the United States to-day are of his production. Mr. Cook is succeeded by Mr. S. G. McMeen.

HON. JAMES D. REID, the veteran telegraph superintendent and U. S. Consul at Dunfermline, Scotland, arrived by American liner "St. Paul" last week in good time to attend the telegraph meetings of this season.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 1, 1896.

Alarms and Signals:—

TOWER STRIKER. F. W. Cole, Newton, Mass., 566,843. Filed July 24, 1894.
Adapted for fire alarm use.

ELECTRICAL SELECTING INSTRUMENT. A. Duppler, Jersey City, N. J., 566,896. Filed Feb. 12, 1895.
Details of construction.

SIGNALING DEVICE. H. L. Webb, New York, 566,951. Filed March 18, 1893.
Adapted for use in connection with telegraphs and telephones to indicate to the different stations on the line when the same is occupied by the transmission of a message.

ELECTRICAL COMMUNICATION. J. A. Sullivan, Cincinnati, O., 567,112. Filed July 15, 1893.
A combination in an electrical instrument in a circuit of a permutation wheel having an armature mounted thereon and attached thereto, the wheel being in such relation to a magnet that the attraction of the magnet causes the rotation of the wheel, a magnet and a battery.

Secondary Batteries:—

PLATE FOR SECONDARY VOLTAIC BATTERIES. J. G. A. Rhodin, Clifton Hill, England, 567,044. Filed Oct. 7, 1895.
Consists of a perforated frame plate, in combination with plugs composed of a bundle of lead wires filling the perforations of said frame plate and producing permeable plugs to the interstices of which the electrolyte has access.

PLATE FOR SECONDARY VOLTAIC BATTERIES. J. G. A. Rhodin, Clifton Hall, England, 567,045. Filed Sept. 25, 1895.
Similar to above.

Distribution:—

ELECTRIC-DISTRIBUTION MACHINE. W. E. Sinclair, Milwaukee, Wis, 566,874. Filed July 25, 1895.
Comprises a series of automatic quick break knife switches, each of which is for incorporation as part of an electric circuit, a power shaft, a counter shaft in gear with the power shaft, and a series of rotarily adjustable switch closing cams carried by the counter shaft.

Dynamos and Motors:—

ELECTRIC MOTOR. J. Bram, Decatur, Ill., 566,889. Filed Sept. 5, 1895.
Capable of operating with either a continuous or an alternating current.

ELECTRIC MOTOR. R. Eickemeyer, deceased; R. Eickemeyer, Jr., executor, Yonkers, N. Y., 567,119. Filed Dec. 31, 1890.
Combination of an armature, carrying coils connected in series; an inside field coil; separate or isolated coils conforming to and massed with the field coil, and one or more outside, or counter field coils, connected in series with the field coil.

Electro Metallurgy:—

APPARATUS FOR EXTRACTING GOLD AND SILVER FROM ORE. P. Danckwardt, New York, 566,894. Filed June 8, 1896.
Consists of a revolving barrel having amalgamated copper lining to form a negative pole, with a pair of heads, and with a series of insulated inclined blades secured to such heads and having overlapping edges to form the positive pole.

CYANID PROCESS OF EXTRACTING PRECIOUS METALS FROM THEIR ORES. R. Keck, Denver, Colo., 566,986. Filed July 3, 1895.
Consists in dissolving said metals in a cyanid solution and extracting them therefrom by electrolytic precipitation upon an aluminum cathode.

Lamps and Appurtenances:—

REGULATING SOCKET FOR ELECTRIC LAMPS. C. A. Chute, Chicago, Ill., 566,892. Filed Feb. 8, 1896.
Details of construction.

ELECTRIC LIGHT HANGER. J. F. Diehl, J. F. Diehl, Jr., and D. Diehl, Pittsburg, Pa., 567,022. Filed Feb. 11, 1896.
Details referring to a mast having a laterally projecting arm, with a movable trolley.

Miscellaneous:—

ELECTRIC HEATER. F. L. Pruyn, Albany, N. Y., 566,795. Filed Aug. 1, 1895.
Comprises an insulating support with spirally coiled conductor encircling it.

ELECTROMAGNET. A. Le Blanc, New York, 566,918. Filed Oct. 16, 1894.
Consists of an outer casing, a core inclosed within the casing both of magnetized material, two coils wound between them, one at each end and separated from each other, thereby forming a double magnet, one at each end, in combination with a movable plate-armature at each end.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. J. M. Murray and A. F. Pierce, Danbury, Conn., 566,786. Filed Sept. 10, 1895.
Sectional conduit system.

MAGNETIC TRACTION APPARATUS FOR MOTOR CARS. W. Robinson, Boston, Mass., 566,800. Filed Oct. 12, 1891.
The combination of a car axle and its wheels, a motor arranged to drive the same and coils of insulated wire surrounding the hubs of the wheel and arranged to magnetize the same.

ELECTRIC RAILWAY SYSTEM. W. Robinson, Boston, Mass., 566,801. Filed Dec. 19, 1894.
Embodies a magnet included in a continuously closed circuit and operated without actually opening the circuit of the magnet, a transformer arranged to energize the circuit with a current of low voltage and means for demagnetizing the magnet by short circuiting.

DETECTOR FOR RAILWAY SWITCHES. W. H. Berrigan, Jr., Brooklyn, N. Y., 566,887. Filed April 26, 1895.
Embodies an insulating contact and a latch for forming part of an electric circuit which controls means to lock or unlock the switching mechanism.

ELECTRIC CAR BRAKE. A. B. Roney, Chicago, Ill., 566,939. Filed April 2, 1895.
The combination with a motor, a screw-threaded shaft driven thereby, and a yielding connection between the shaft and the armature of the motor, of a nut working on the shaft and held against rotation, and a brake rod connection with, and actuated by the nut.

ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 566,984. Filed Feb. 3, 1896.
Consists of a current collector embodying a trolley and a guide wheel adapted to keep the trolley in place.

TROLLEY. F. W. Canales, Portland, Me., 567,118. Filed Jan. 22, 1896.
Details of construction.

Regulation:

ELECTRICAL CONSTRUCTION, REGULATION AND DISTRIBUTION. T. H. Hicks, Detroit, Mich., 566,860. Filed Feb. 1, 1895.
Designed for employment with a gas engine.

AUTOMATIC STARTER FOR ELECTRIC MOTORS. J. E. Putnam, Rochester, N. Y., 566,936. Filed Feb. 29, 1896.
Comprises variable resistance contacts, operating lever and contact lever provided with a lug, the springs on the lever, and suitable means driven by the motor for operating the lever according to the speed of the motor.

AUTOMATIC CIRCUIT CONTROLLER FOR ELECTRIC PUMPS. D. W. Dunn, Wrentham, Mass., 567,023. Filed May 1, 1895.
Comprises the piston of a pump which is exposed to the pressure of the air in the reservoir and a switch whose moving member is moved up to a dead point by power stored up during its motion up to the dead point.

Switches, Cut-Outs, Etc:

ELECTRIC SWITCH. J. L. Hornig, St. Louis, Mo., 566,760. Filed Feb. 26, 1896.
Comprises a rotating disc, conductor plates passing through the disc and a spark arrester consisting of non-conducting elastic material so positioned as to engage yieldingly against the periphery of the disc.

Telegraphs:

ELECTRIC SELECTOR. A. Le Blanc, New York, 566,914. Filed Oct. 3, 1893.
Adapted to be operated by the transmission of electrical impulses sent out by the ordinary telegraph key or a pair of keys so arranged as to be capable of transmitting currents of opposite polarity.

ELECTRIC SELECTOR. A. Le Blanc, New York, 566,915. Filed Nov. 11, 1893.
Similar to above.

SELECTING DEVICE. A. Le Blanc, New York, 566,916. Filed Jan. 16, 1894.
Similar to above.

ELECTRICAL TRANSMITTING INSTRUMENT. A. Le Blanc, New York, 566,917. Filed Oct. 16, 1894.
Details of construction.

TELEGRAPHY. J. M. Joy, New York, 566,985. Filed June 17, 1895.
A closed circuit system for printing telegraphs.

Telephones:—

VILLAGE OR HOUSE TELEPHONE SYSTEM. E. G. Hovey, Chicago, Ill., 566,762. Filed May 4, 1895.
A signaling device adapted to be sounded when the subscriber has neglected to return the plug to its individual switch socket.

SELECTIVE SYSTEM. A. L. Merrick, J. Merrick, administratrix, and H. Brooks, Springfield, Mass., 566,784. Filed Sept. 16, 1892.
Means by which a signal may be given from one station to any one of several other stations in one electrical circuit.

TOLL-BOARD APPARATUS FOR TELEPHONE EXCHANGES. V. Wietlisbach, Bern, Switzerland, 566,829. Filed Feb. 1, 1895.
Details of construction.

TELEPHONE TRANSMITTER. N. L. Burchell, Washington, D. C., 567,077. Filed Sept. 5, 1895.
A two-diaphragm transmitter, employing granular conducting material.

OBITUARY.

J. T. RIDGWAY.

Col. Joseph T. Ridgway, Superintendent of the Trenton Electric Light Company, shot himself in the head on Sept, 3 at his home in Trenton, N. J. Col. Ridgway underwent an operation in Philadelphia several months ago, and since then his mind has not been strong. He went to Tuckerton for his health, but returned home recently. He acted queerly and was watched by his family. He managed to elude his watchers and killed himself. Col. Ridgway was a civil engineer, and was at one time a member of the Trenton Board of Public Works. He served in the U. S. Navy during the War of the Rebellion. Several years ago he was the superintendent of the now defunct Star Rubber Works. He was over sixty years of age.

H. J. TUCKER.

A news dispatch from Colorado announces the death at Denver of Mr. H. J. Tucker. He was well known to the mining men of that district from being connected with the Marvin Electric Drill Company, of Canastota, N. Y., one of the plants of which was placed in operation by Mr. Tucker at the Columbine-Victor Tunnel on Squaw Mountain. He was a young man and possessed more than ordinary ability as electrical engineer. He graduated from Brown University and the Massachusetts Institute of Technology and had a most promising future in the electrical field before him. His friends were much pained and surprised to learn of his death. The deceased's former home was Pawtucket, R. I., where his mother and sister still reside.

Trade Notes and Novelties

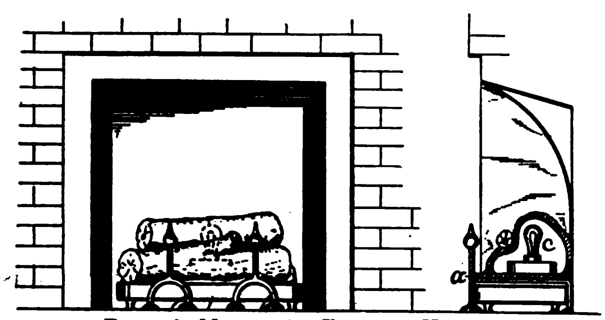
AND MECHANICAL DEPARTMENT.

DEWEY'S ILLUMINATED ELECTRIC HEATER.

ONE of the chief reasons for the continued existence of the old-fashioned open fireplace is its cheerful appearance, which is lacking in the case of electric heaters of the usual pattern. To overcome this deficiency, Mr. Mark W. Dewey, of Syracuse, N. Y., has invented an attachment for an electric fireplace which will have all the advantages of an open grate while avoiding the dust and dirt incidental to this manner of heating. The "stove" itself may consist of any form of electric heater in addition to which illuminated artificial fuel is used to supply the deficiency in appearance.

The device provides a heating apparatus for rooms that may be placed in an ordinary fireplace and which will not only radiate heat but light. The heater is also so constructed that it resembles the appearance of fuel when light is radiated from it.

The illustration represents an ordinary open fireplace where coal or wood is burned. Upon the grate or andirons there is an inclosure. The bottom and back, and ends in some cases, may be made of metal or wood, and are made to fit the walls



DEWEY'S METHOD OF ELECTRIC HEATING.

of the fireplace. The cover for this box, which includes the top and front, and in some cases the ends, is constructed of a transparent or semi-transparent material, as glass or mica. This cover is removable from the box and resembles ordinary fuel, as coal or wood, in a state of combustion when the light is radiated through it, and may also be made to resemble the same materials when not in such state when light is not radiated through it. This cover is made of glass so as to give the general shape that coal or wood would be placed in for a good fire. The interior surface is made smooth and the exterior surface rough. Within this cover are incandescent lamps, as shown in the illustration, the bulbs of which may be colored so as to produce any desired tone of illumination. The illuminating heater may either be used alone or in connection with any type of electric heater.

SALES OF THE BALL ENGINE CO.

The Ball Engine Company, Erie, Pa., report an encouraging increase in orders during the past few weeks for engines for electric work. Shipments for the past month are as follows: Bradford Electric Railway Company, Bradford, Pa., one 200 horse-power cross compound engine; village of Willmar, Minn., one 100 horse-power engine; Fox Pressed Steel Company, Pittsburg, Pa., one 100 horse-power engine, direct-connected to Westinghouse generator; Henry Sonneborn & Co., Baltimore, Md., one 25 horse-power engine, direct-connected to General Electric dynamo; Rogers, Peet & Co., store building, Broadway, New York City, one 25 horse-power engine and one 100 horse-power engine; National Galvanizing Works, McKeesport, Pa., one 175 horse-power engine; National Tube Works, McKeesport, Pa., one 175 horse-power engine, direct-connected to Crocker-Wheeler dynamo; Iowa Agricultural College, Ames, Iowa, one 60 horse-power engine; J. Q. Howe's Sons electric light plant, Phelps, N. Y., one 100 horse-power engine; Cambridge Fuel Company, Byersville, Ohio, one 125 horse-power engine for electric mining; Institute for Blind, Janesville, Wis., one 40 horse-power engine; Bertha Mineral Company, Bertha, Mo., one 70 horse-power engine; Crook, Horner & Co., Baltimore, Md., one 35 horse-power engine; Gobierno del Distrito Federal, Mexico City, one 80 horse-power and one 30 horse-power engine; H. V. Phelps, Nitta Yuma, Miss., one 25 horse-power engine; Toledo Glass Company, Toledo, O., one 100 horse-power engine.

BURHORN & GRANGER.

Burhorn & Granger, 136 Liberty street, New York City, are at present installing three Woodbury engines in this vicinity, including one 9 x 12 direct connected to Eddy generator, at the Merritt apartment house, Eighty-first street and West End avenue; one 9 x 12 for the Safety Insulated Wire and Cable Company, 229 West Twenty-eighth street, and one 9 x 12, at Schneider's building, Union Hill, N. J. They also report the following recent installations: One 9 x 12 direct-connected to Fort Wayne generator, for the D. Jones Brewing Company, Forty-fourth street and First avenue, this being the combination which attracted such favorable notice at the recent Electrical Exhibition; one 12 x 14 and one 9 x 12 direct-connected, at the new Hotel Mathewson, Narragansett Pier, R. I.; one 7 x 10, at the Highland Spring Brewery, Boston; one 7 x 10, for G. M. Angier & Co., Boston; one 8 x 12 for the old Colony Brewing Company, Fall River, Mass.; one 11¼ x 14, Western Electric Company, Chicago , Ill.; two 13 x 16 Irondequoit Park Railroad, Rochester, N. Y., and a large consignment for the Osaka Electric Light Company, Osaka, Japan, including three 8 x 12, one 9 x 12, one 14 x 18, one 9¼ x 14, 14 x 14 tandem compound, and three 13½ x 23 x 16 tandem compounds.

The machine shops and the boiler shops of the Stearns Manufacturing Company, Erie, Pa., the builders of the Woodbury engine, are well filled with work on hand at the present writing.

NEW ENGLAND NOTES.

THE JOHN BECKER MANUFACTURING COMPANY, of Fitchburg, have made a huge success of the Becker vertical milling machine, and are now working thirteen hours a day to fill orders. The Becker miller was brought out only a few years ago, but has gained wonderfully in patronage, and now that Mr. Becker has added some larger sizes, he is taxed to the utmost to fill orders. All manufacturers desiring a thoroughly satisfactory milling machine, which can perform an amazing variety of work, should send to Fitchburg for a descriptive circular.

NEW YORK NOTES.

CHAS. J. BOGUE, 206 Centre street, has a busy shop at present, rewinding armatures and refilling commutators which are his specialties. Mr. Bogue manufactures carbon holders for all types arc lamps, also arc lamp supplies, American system, and will take pleasure in sending prices, etc., on application.

C. A. ECK, formerly of 116 Wooster street, New York, has removed his factory, and is now located at 159-161 Oraton street, Newark, N. J. Mr. Eck manufactures electric motors, dynamos, electro-plating machines and rheostats, and will be pleased to mail circulars and prices, etc., on application.

MR. EUGENE E. BOGART announces that he has bought out the old business of the late Abraham L. Bogart, 22 Union Square, in electric, gas lighting and other well known specialties, and that it will be actively continued. The practical and mechanical departments will be in the able hands of Mr. A. L. Bogart. Both gentlemen have the heartiest good wishes of a large circle of friends.

H. B. COHO & COMPANY have been appointed New York agents for the Translucent Fabric Company, of Quincy, Mass. This company manufactures a translucent fabric which can be used as a substitute for glass chiefly in skylights. This fabric is impervious to the weather, unaffected by heat, cold, expansion or contraction, flexible, durable and unbreakable. Electrical engineers in designing modern central stations should investigate this material before deciding on glass.

THE PHOENIX GLASS COMPANY, 42 Murray street, have been awarded the contract to fit up the new Manhattan Hotel, Forty-second street and Madison avenue, entire, with specially designed silver etched electric shades. They have also the contract for the entire City Hall, Philadelphia. The electric lights are furnished with their cut globes and boles ground on inside. The Masonic Temple, Detroit, Mich., is also installed with specially designed goods of this firm's make.

WM. A. ROSENBAUM, electrical expert and patent solicitor, Times Building, reports that although general business may be dull, there is an indication in the patent business that people have not given up hope of better times. While there are comparatively few applications being filed in the patent office at this time, there is now a growing disposition by those operating under patents to have thorough examinations made to determine the exact status of the patents they control. Mr. Rosenbaum thus finds himself busy almost entirely in making validity searches and reports and in furnishing general advice to many of his clients as to what can and what cannot legally and properly be manufactured and used.

STORAGE BATTERIES IN FIRE ALARM WORK.

The growth of the application of storage batteries in fire alarm work, displacing gravity cells, is indicated by the fact that during the past two years, 10,422 chloride accumulators manufactured by the Electric Storage Battery Company, have been installed in that service. Forty-seven cities are now equipped with the storage system. The Gamewell Fire Alarm and Police Telegraph Company is installing chloride accumulators wherever conditions permit.

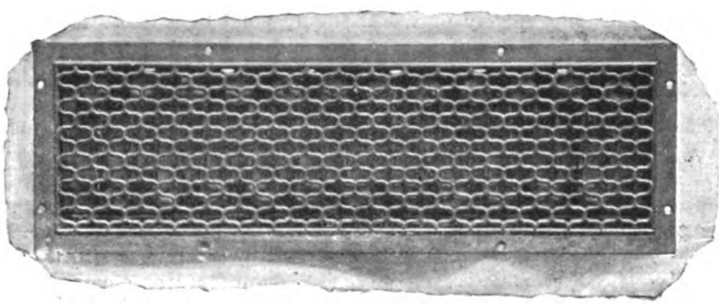
"THE MINERAL INDUSTRY."

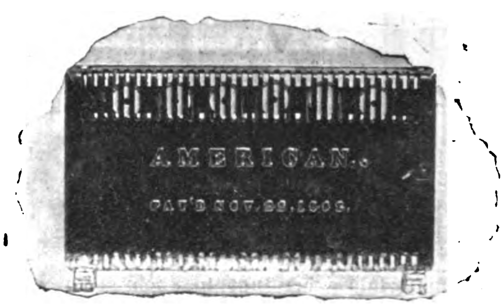
There is nothing equal to this book as an encyclopedia of all that relates to the condition of the mineral industries of the world. It is issued annually by the Scientific Publishing Company, of 253 Broadway, and we are glad to learn that Vol. IV. is now ready. The price is $5 per volume. The work is always well bound, clearly printed, and usefully indexed. The present volume, like its predecessors, contains several special articles.

ELECTRIC CAR HEATERS.

THE AMERICAN ELECTRIC HEATING CORPORATION, of Boston, Mass., who are exclusively engaged in the manufacture of all kinds of electric heating apparatus, are now preparing to push their styles of street car heaters, two of which we illustrate in the accompanying engravings. Fig. 1 represents a panel heater for side seat cars, designed to be placed with its front flush with the riser under the seat, giving the effect of a furnace register. This heater is but 3 inches deep (from front to back), and has ample space for free circulation of air to and from the coils, thus insuring the uniform heating of a large amount of air to a moderate temperature as well as providing for considerable direct radiation from the coils. It is finished in gold bronze.

Fig. 2 illustrates the type E heater, which is designed for long cars with cross seats, where it is desirable to have a larger number of heaters of smaller capacity than those used in shorter cars. This heater is furnished to fasten to the floor or suspend from the seat frame, and will fit under the shortest cross seats. Type E heater is finished in black enamel.





FIGS. 1 AND 2.—ELECTRIC HEATERS OF AMERICAN ELECTRIC HEATING CORPORATION.

PRESIDENTIAL FACTS AND FIGURES.

This is an unusually interesting year in politics, and one in which facts and figures are peculiarly desirable. The Central Electric Company, of Chicago, shrewdly aware of this, has issued a very neat and handy little manual about the presidential candidates and about the votes in previous years, both of the people and of the electoral college. A valuable feature also is the inclusion of the two platforms, those of the Republican and the "Democratic" parties.

150 HOUR ARC LAMP—A CORRECTION.

In our issue dated September 2, the advertisement of the General Incandescent Arc Light Company read: "Bergmann Long Life Lamp, 50 Hours," but should have read 150 hours. These lamps are in growing demand and meet with unqualified approval by reason of the saving in labor and annoyance their long life effects.

THE ELECTRIC APPLIANCE CO. is carrying a large and well-assorted stock of the celebrated "Electra" imported carbons, which are recognized as a very high grade article. They have an exceptionally long life, owing to the fact that almost the entire carbon is consumed, the amount of dust being reduced to a minimum. Prompt shipments are made from Chicago stock.

WESTERN NOTES.

J. HOLT GATES has removed his office from 311 Dearborn street to suite 1143 Marquette Building, Chicago, where the agencies of the Walker Company and the C & C Electric Company will henceforth be.

THE AMERICAN STORAGE BATTERY COMPANY has been formed in San Francisco, with a capital stock of $25,000, of which $50 is paid up. The incorporators are W. T. Bell, T. Z. Hardee, E. M. Massey, B. H. Bancroft and C. S. Preble.

THE ELECTRIC APPLIANCE COMPANY has been successful during the past month in closing some large deals for "O. K." weather-proof wire. Several orders for good sized complete new plants have been booked, together with some large orders for extensions for already existing plants.

MR. F. P. LEUTHER, former manager of the Western Electric Heating Company, St. Paul, Minn., has been appointed Chicago manager of the American Electric Heating Corporation, of Boston, with an office at 1644, the Monadnock Block, where he will carry a full line of their goods to supply the Western trade.

MR. CARTER H. FITZHUGH, 1634 the Monadnock Block, Chicago, will continue to represent the American Electric Heating Corporation in that section as agent for the sale of their make of electric heaters for street cars. Mr. James I. Ayer, general manager, the American Electric Heating Corporation, Boston, was a Chicago visitor last week.

THE LONG DISTANCE ELECTRIC TELEGRAPH CO. has filed articles of incorporation in St. Louis, Mo. The business the new firm will engage in is the manufacture, use, and sale of mechanical appliances, transmitters, receivers and devices connected with linotype or other type-setting machines. The company incorporated with a fully paid-up capital stock of $100,000. The stock is owned as follows: Joseph Riefgraber, 991 shares; Clarence P. Connolly, 5 shares; Charles Lenz, 2 shares; Jacob Handelmann, 1 share; Julius Friedman, 1 share.

ADVERTISERS' HINTS.

ATTENTION IS CALLED by the General Electric Company to their slow and moderate speed generators and motors. They carry as many as fourteen sizes in stock ranging from 2½ to 75 kilowatts.

THE CROCKER-WHEELER ELECTRIC COMPANY have made a special study of the equipment of factories with electric power. Among other large plants they have thus installed may be mentioned the Baldwin Locomotive Works, Philadelphia, and the Cambria Iron Works, Johnstown, Pa., and in all cases the most satisfactory results have followed.

THE COLBURN ELECTRIC MANUFACTURING COMPANY are now extensively represented in the United States. Their agents are Baker Bros., Toledo; Missouri Electric Repair Company, St. Louis; Illinois Electric Company, Chicago; and C. P. Hutchinson, Salt Lake City. They make an excellent machine for electro-plating.

THE AMERICAN ELECTRIC HEATING CORPORATION are selling an electric stove with cord and plug for $4. The stove requires two amperes on a 110 volt circuit.

THE S. & B. ELECTRIC COMPANY are stocking a very full line of supplies and novelties, their catalogue of which, with discounts, they will mail on request.

THE CUTTER ELECTRIC AND MANUFACTURING COMPANY illustrate an "I-T-E" mercury contact circuit breaker for use on motor circuits. These circuit breakers are now recognized as standard.

THE CENTRAL ELECTRIC COMPANY are offering a three inch, iron box, snap cover bell at twenty-two cents. This is not their only bargain.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. SEPTEMBER 16, 1896. No. 437.

POWER TRANSMISSION.

THE NEVADA COUNTY (CAL.) ELECTRIC POWER CO.

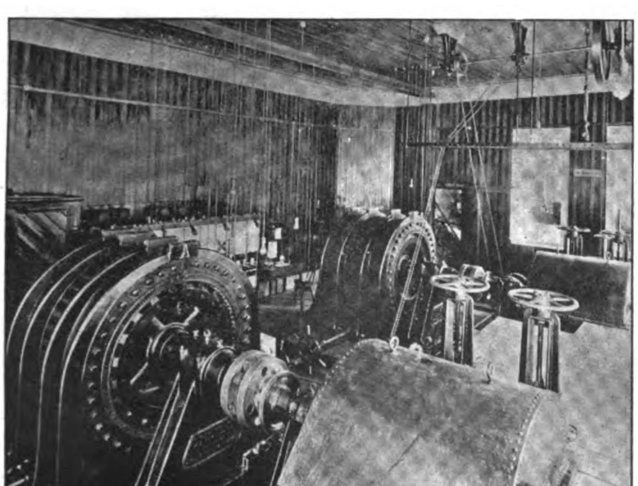
Mountain Pole Line.

A LITTLE more than one year ago work was commenced on the plant of the Nevada County Electric Power Company. To-day it is giving twenty-four hour service to 3,400 incandescent lamps and 32 horse-power in motors, with contracts ahead for 450 horse-power in synchronous motors. The plant has been in operation since Feb. 5, and has given commercial service from the start. Till June 12 the service extended from 4.30 p. m. to 9 a. m.; since that date the plant has been in continuous operation.

On the South Yuba River, 1½ miles above Purdou's bridge, is built a log crib dam, 28 feet high and 150 feet on the crest, which diverts water to the flume 6 feet wide and 5 feet high, which with a grade of 10 feet per mile follows the windings of the canyon for 18,000 feet. The rugged nature of the country and the difficulty of the work is well shown by the accompanying engravings.

At the end of the flume a head of 206 feet is attained and the water is carried to Pelton wheels through 300 feet of 48-inch, 44-inch and 42-inch pipe, giving in round numbers about 2,500 horse-power.

The power house is a stone, wood and corrugated iron building, 28 feet by 40 feet, having one large room with 20-foot ceiling, in which are installed at present two 340 kilowatt Stanley two-phase, 5,000 or 2,500 volt generators connected by special insulating couplings, shown clearly in the engravings,



INTERIOR OF POWER HOUSE.

to two 34-inch Pelton wheels running at 400 revolutions per minute; two Crocker-Wheeler 5 kilowatt bipolar exciters belted to two No. 5 Pelton motors; one No. 3 Pelton motor running at a constant speed to drive the differential governors; and a suitable switchboard.

Current is delivered to the line at 5,000 volts direct from the generators, saving the loss of power and extra complication of step-up transformers. It may be of interest to note that

FLUME LINE ON SOUTH YUBA RIVER.

there has not been a moment's trouble with, or the least item of repairs to, the generators thus far.

The pole line is very substantial and carries two complete circuits of four wires each on triple petticoat porcelain insulators. No. 3 bare copper wire is run to a point 4 miles from the power house where the circuits branch. No. 6 bare copper is run from here one mile to Nevada City, and four miles to Grass Valley. In both towns all wire is insulated.

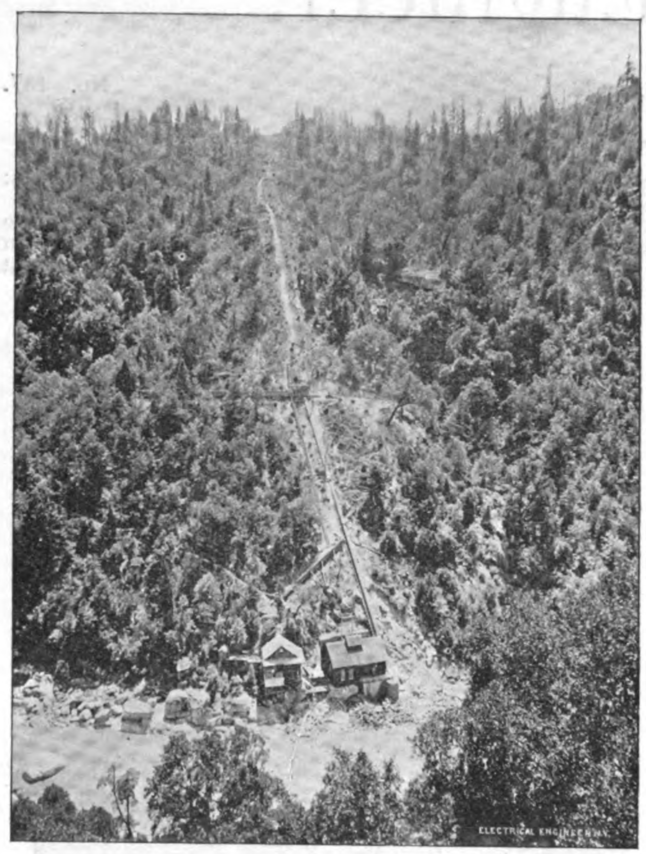
A No. 6 iron wire, run on the tops of the poles and grounded at every other pole, was intended to protect the system from lightning, but it has been found entirely inadequate and Wurts non-arcing metal arresters have been installed at the power house and at the terminals of all branches.

At both towns sub-stations have been established with elaborate switchboards and step-down transformers which reduce the line pressure to 2,000 volts for lighting and small power distribution. There are furnished now 1,600 incandescent house lights, 58 25 candle-power series incandescent street lights and four alternate current arcs in Nevada City; and 1,800 incandescent house lights and 40 arcs for street lighting in Grass Valley.

The motor business is very promising, but mining men are slow to adopt the new power till they see it in successful operation elsewhere. The first mine to adopt electricity for both lighting and power near Nevada City was the Red Hill, Limited, which is using a 30 horse-power Stanley two-phase induction motor to drive a Griffin mill, which has been running successfully since June 12. The second installed was a 2 horse-power Stanley two-phase induction motor for driving a concentrator and pump working the tailings from a large mine, and has been in almost constant service since the latter part of June. The third motor to be installed is a 120 kilowatt synchronous motor to drive an air compressor at the Gold Hill mine, near Grass Valley, where it was decided to

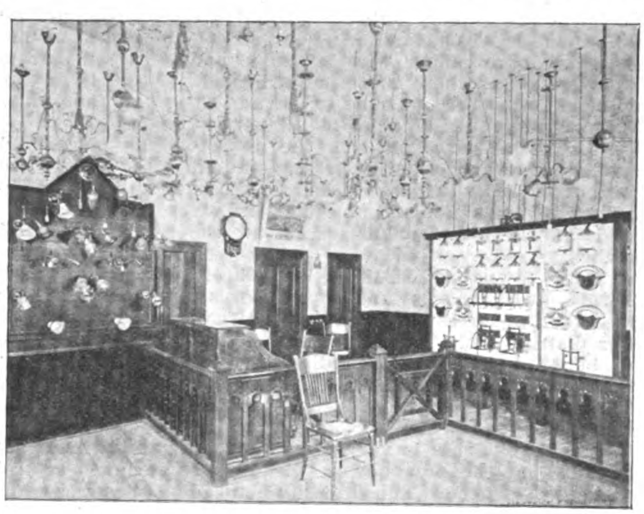
use compressed air in order to utilize the engines already installed; it is also intended to use the steam boiler already in place as a receiver and reheater as well as reserve in case of accident to the electric machinery; this motor will start up in a few days.

For about three months it was necessary to run at 2,000



Power House, Flume and Penstock.

volts, which was very easily accomplished by changing the connections on the generators and cutting out the step-down transformers. With this arrangement, however, it was found difficult to keep the phases balanced, but it was accomplished very well by means of an iron wire inductive resistance. Since changing back to 5,000 volts no trouble has been experi-

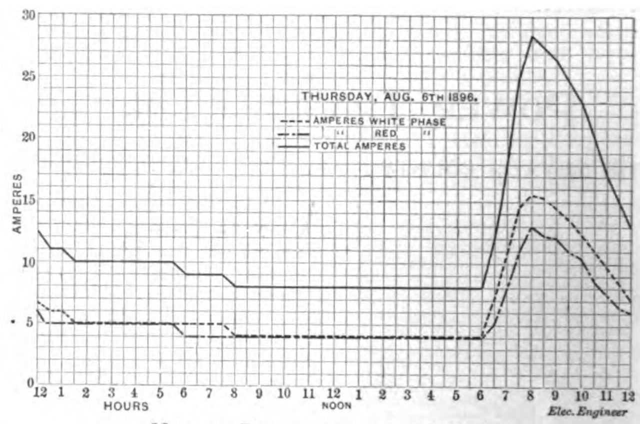


Grass Valley Office, Showing Sub-Station Distributing Board.

enced with unbalanced phases, and the difference in voltage between the two towns has been very little, even when the heaviest load is in, in fact it is often two volts higher (on the 100 volt circuits) at Grass Valley than at Nevada City.

One hundred volt 3.6-watt lamps are used exclusively for house lighting and the Edison base has been adopted as standard for them. For the few 50 volt lamps it is necessary to use the Thomson-Houston base has been adopted. The accompanying diagram shows the load curve as taken from the power house reports of August 6.

The conception of the plant is entirely due to the superintendent, Mr. A. Fregidgo, and the success of the enterprise is due to the energy and ability of the general manager, Mr. E. J. de Sabla, Jr. The consulting engineers for the installation were Messrs. Hasson & Hunt and Mr. W. R. Eckert, of San Francisco. The machinery was installed by Mr. Jno.

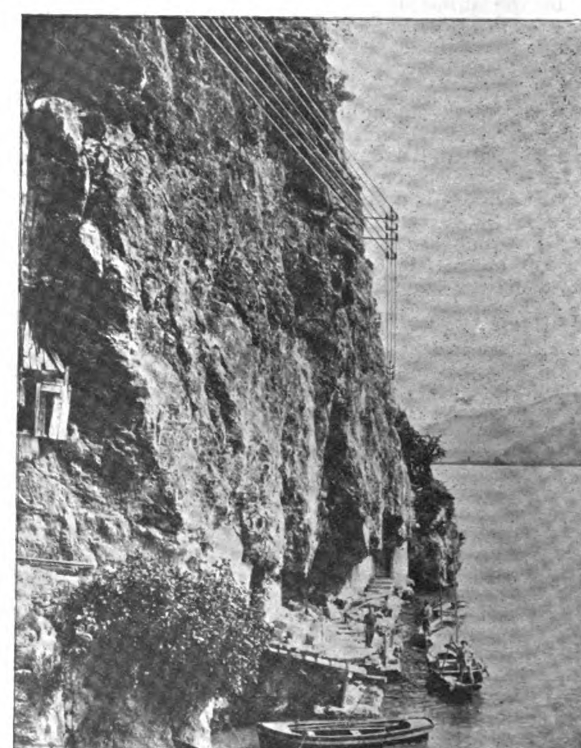


Nevada Power Plant Load Curve.

Martin, Pacific Coast agent for the Stanley Electric Manufacturing Company, who were represented in the field by Mr. E. E. Stack. The electrical portion of the plant since starting has been under the direction of Mr. L. M. Hancock.

ELECTRIC POWER ON THE GARDA LAKE, AUSTRIA.

ONE of the main beauties of electric power is its flexibility of application, rendering easy and economical the performance of work which, with any other methods would be difficult and expensive, if not impossible. A plant recently in-



Three-Phase Electric Power Transmission on the Garda Lake, Southern Austria.

stalled by the Oerlikon Works, Zurich, Switzerland, affords a good illustration of the handiness of the electric motor. The cut herewith shows the plant in operation on the Garda Lake, Southern Austria, the line being seen at the top of the bluff and the work going on along the water's edge. The system

used is three-phase at 2,000 volts, and the apparatus is answering its purpose very satisfactorily.

THE ELECTRICALLY DRIVEN MILLS OF THE PELZER MANUFACTURING CO., PELZER, N. C.

THE advantages incident to the driving of textile mills by electricity instead of by belt or rope drive from a steam engine are perhaps nowhere more emphatically demonstrated than in the great cotton mills of the Pelzer Manufacturing Company, at Pelzer, N. C. This company, organized in 1860, had gradually increased its manufacturing facilities until in the spring of 1894 it had not less than 53,500 spindles in operation in the three mills which it had located on the Saluda River. The entire power of the river at that point it then utilized to drive two of the mills. Mill No. 3 was driven by a belt from a 400 horse-power engine of Corliss type.

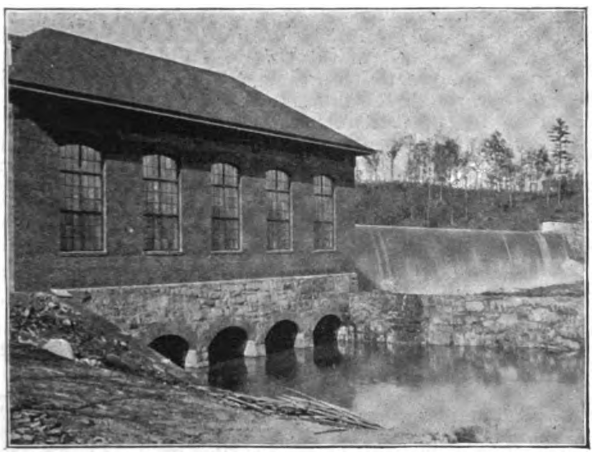


FIG. 1.—POWER HOUSE AND DAM, PELZER COTTON MILL PLANT.

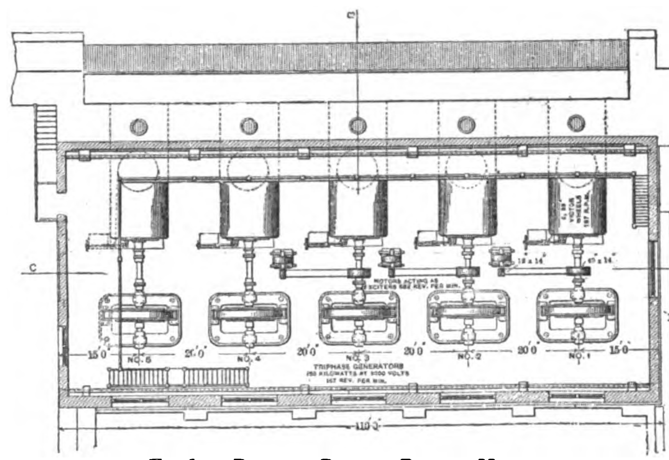


FIG. 2.—PLAN OF PELZER POWER HOUSE.

The Pelzer Company owned a large tract of land immediately adjoining the mills, and upon this it had erected besides the three mills just mentioned, three churches, schools, stores and the factory village, the whole property being controlled and supervised by the president, Capt. E. A. Smythe. The village is located about three-quarters of a mile from the Columbia and Greenville branch of the Southern Railroad, and a spur track is run from the line to the village. The corporation controls the Saluda River for several miles on each side of the Pelzer village, and in this distance owns a number of undeveloped water powers, in addition to those it had already utilized. The growth of the business of the Pelzer Company rendered an increase in the manufacturing plant necessary, and in 1894 plans were drawn for a new 55,000 spindle mill. The question of driving the mill, and consequently, its location, became the most serious it had to consider. A magnificent undeveloped water power existed not three miles down the stream from the present village, but if the new mill were to be erected by the side of this water power, it would be necessary to duplicate the mill village, etc., and would entail the cost of additional supervision, the distance between the two villages being too great to bring the new mills under direct supervision of the mills 1, 2 and 3. The formation of the land adjacent to the water power was also unfavorable to the erection of a mill at that point, unless at great expense. It would have been necessary to lay very heavy stone founda-

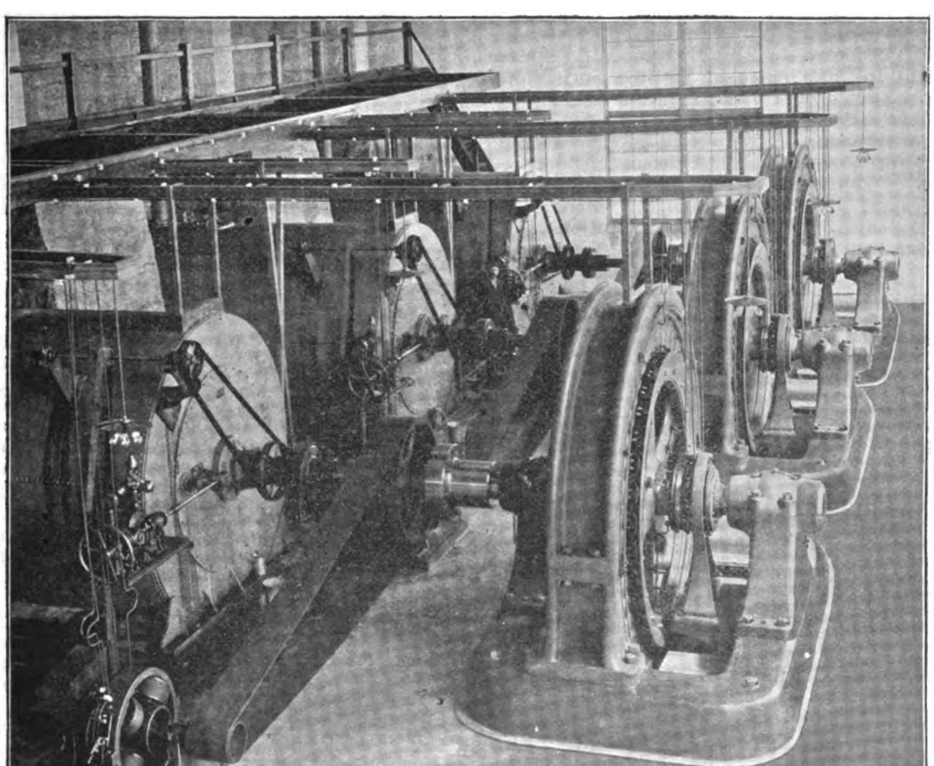


FIG. 3.—GENERATING PLANT, PELZER COTTON MILL POWER TRANSMISSION.

tions under the entire building, which had been planned for 505 feet in length and 128 feet wide, as well as to extend the railroad track from the old to the new village. Before the magnitude of such a project even such enterprising mill owners as the Pelzer Company recoiled.

A little before this time the owners of large cotton mills at Columbia, S. C., had decided to use electricity to drive their machinery. Their plant was already in operation and giving

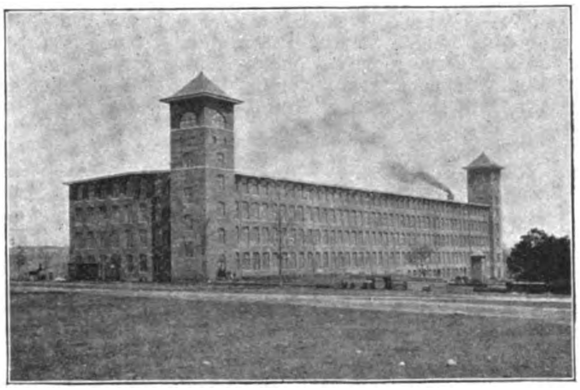


FIG. 4.—NEW NO. 4 PELZER MILL OPERATED ELECTRICALLY.

satisfaction, and the Pelzer Company, after an exhaustive examination, made a contract with the General Electric Company, in October, 1894, for an entire electrical three-phase generating and insulation motor equipment for the new mill, and a synchronous motor equipment for mill No. 3.

The plans were altered accordingly to comprehend a power house only at the site of the water power, and the erection of mill No. 4 itself in the vicinity of mills 1, 2 and 3. The new mill is 505 feet long by 128 feet wide, four stories high and contains 55,027 spindles. To obtain the necesary fall with a sufficient storage of water, a dam of solid masonry 32 feet high and about 450 feet long was thrown across the Saluda River, a spillway 300 feet long being provided in view of occasional heavy spring freshets. The available power is set down at 5,500 horse-power. The power house is of red brick, laid on masonry foundations, the walls being waterproofed for three feet above the top of the stone. The dam and power house were constructed by William Chapman & Company, Providence, R. I., and the water wheel plant by the Stilwell-Bierce and Smith-Vaile Company, of Dayton, O. Wheel pits and feeders are provided for five pairs of 29-inch horizontal Victor wheels, each of which, under the available head, will develop 1,000 horse-power. Three pairs of wheels only have been installed, but the other two will be put in as soon as the increase in the demand for power warrants the extension.

Each pair of turbines is connected to the armature shaft of a 1,000 kilowatt three-phase generator, delivering current at 3,300 volts when turning at a speed of 167 revolutions per minute. The exciters are multipolar dynamos of the General

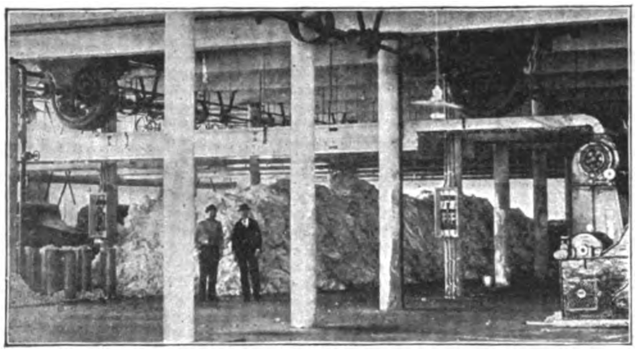


FIG. 5.—PICKER ROOM, PELZER MILL, WITH CEILING MOTOR.

Electric slow speed type, and are directly driven by belts from the turbine shafts. The switchboard of the skeleton type located in the gallery, carries the special high tension switches the synchronizers and usual rheostats and measuring instruments, the busbars receiving the current direct from the generators without transformation. The high tension wires rise from the board to a small monitor on the dam side of the power house and pass out through this to the special glass insulators on the poles. These carry four cross arms. The top one carries two wires acting as lightning conductors grounded at every third pole; the second, third and fourth cross arms carry the generator circuits, while on the lowermost are strung the pressure and telephone wires. The total length of the pole line is 2⅝ miles. Three-quarters of a mile from mill No. 4 the wires for the synchronous motor in mill No. 3 branch off from the main line.

A small tower erected immediately in front of the new mill receives the high tension wires which are carried down the interior and proceed into the basement of the mill by an underground tunnel. In the tower are contained the lightning arresters. The transformer room adjoining the repair shop in the basement receives the wires through porcelain lined holes in the wall, on a skeleton board carrying the necessary switches. The transformers are nine in number, three of which have a capacity of 265 kilowatts, and six of 275 kilowatt capacity. They are of the G. E. air blast type, in which the principle employed to keep them cool is to send a constant current of air through the laminations by means of two electric blowers. In the transformers the pressure is reduced to 200 volts, at which pressure the current is brought to the motors. There are also two transformers reducing the current to 114 volts for the 1,200 incandescent lamps used to light the establishment.

The motor equipment of the new mill aggregates 2,080 horse-power, divided into twenty-four motors, all of the G. E. induction type and located throughout the building as follows: Two of 50 horse-power each in the basement to drive the

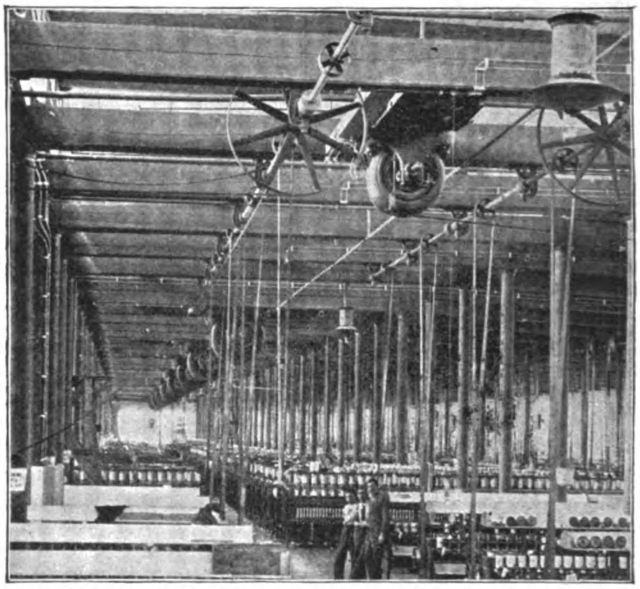


FIG. 6.—SPINNING ROOM, PELZER COTTON MILL, MOTORS ON CEILING.

blowers for ventilating, heating the repair shop, etc. Four of 75 horse-power each in the picker room on the first floor. These are directly connected to the shafting in the same manner as at the Columbia, S. C., mills, and run at 600 revolutions per minute. Four of 110 horse-power each, driving 720 looms on the first floor and 680 on the second floor, as well as five slashers. Three of 110 horse-power each, driving the carding machines of the third floor. Eight of 110 horse-power each, driving the machinery in the spinning room on the fourth floor. One of 20 horse-power operates the spoolers in this room and four of 5 horse-power supply power for the operation of the pumps. All of the above motors are non-synchronous, and are of the inverted type. They are suspended from the ceilings of the rooms in which they are employed. They have neither brushes, collector rings nor commutators, and consequently there is no sparking. The principal advantage presented by these motors is that they necessitate no attention whatsoever beyond that given to the bearings, and so long as these are kept properly lubricated, the motor will satisfactorily perform its duty. They are self oiling and are provided with oil glasses, by which the attendant can readily determine the amount of oil in the oil chamber. By fastening these motors to the ceiling a great saving in floor space is effected, and they are there beyond interference from curiosity, carelessness or accident.

To drive the machinery, each motor is, as far as possible, connected by four belts, two overhanging pulleys being keyed to each end of the motor shaft. From each end

the two belts lead in opposite directions to the shafting driven by the motor. This method of driving reduces to a minimum the amount of friction, while equalizing the strain upon the bearings and shaft. In cases where two belts only are driven by a single motor the pulleys are placed on one end of the motor shaft only, and the belts are led in opposite directions to the machinery shafting.

A glance at the economy induced by the adoption of electricity shows that the erection of this plant cost very little more than it would have done had the mill been located at the dam, on account of the expensive stone foundations which would have been required, the duplication of the mill village and the extension of the railroad. The mill instead of being located on low lying land near a river, is on a high, dry tract, where it receives the best light and ventilation. A considerable saving was effected in both shafting and belting. The widest belt in this mill using 2,200 horse-power is only 8 inches wide—the largest shaft 2 15-16 inches in diameter. The saving in first cost of shafting and belting compared with that in a mill of identical proportions driven by mechanical methods, can be set down at about $10,000. The omission of the belt tower, and its accompaniments, resulted in economizing a sum between $3,000 and $5,000. In mill No. 3, substitution of the 400 horse-power synchronous motor for the steam engine will do away with an annual expenditure for fuel of $10,000. The steam required for heating and slashing in this mill is supplied from the boilers in Nos. 1 and 2 mills, and thus the entire cost of fuel used in No. 3 mill will be saved by the substitution of the synchronous motor. This saving would more than equal the entire operating expenses, including interest on the electric plant driving both No. 3 and No. 4 mills, and lighting the latter. In other words, the cost of power for these two mills and the cost of lighting one of them would be no more than if the steam engine had been retained in No. 3, and No. 4 had been erected near the water power to be driven therefrom mechanically. All of the advantages of concentration, subdivision of power, more favorable transportation facilities, better light, and better ventilation are obtained without adding anything to the cost of manufacturing the output. On the other hand, it is obvious that they must result in a very material reduction in its cost.

ELECTRIC TURRET GEAR FOR FRENCH WARSHIPS.

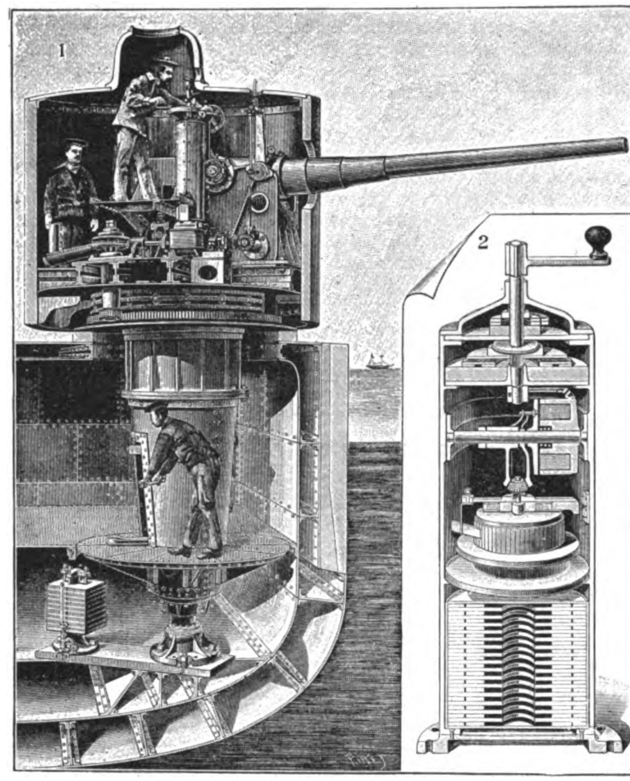
NOWADAYS when so much depends upon the rapidity with which the guns can be handled in naval warfare no pains are spared to apply the latest improvements to this department of naval ordnance. An arrangement for the rapid handling of guns, adopted in a number of French warships, is that illustrated in the accompanying engraving taken from "La Nature." As will be seen, the turret and the gun carriage are placed on a platform which revolves on rollers, the whole resting on a vertical column, which, in turn rests on a hydraulic pivot placed close to the keel of the vessel. This hollow column encloses the apparatus for raising the ammunition to the gun from the magazine below.

Two men operating a crank and revolving the pinion which gears with the circular platform on which the gun rests, can turn the gun and turret, but this method is only employed in emergency, as it is much too slow for regular work. The actual manipulation is carried out by means of a controller, shown in an enlarged view in the illustration. By means of this controller the turret can be revolved at any desired speed by a simple turn of the handle which introduces more or less resistance into the circuit. This movement suffices for the rapid traversing of the gun.

It is also necessary, however, to be able to stop quickly in any desired direction. This is also carried out by the displacement of the handle, which transforms the motor into a generator, thus acting as a brake and stopping the movement of the turret suddenly. A special arrangement then permits of giving the turret a very small angle of rotation to the right or left, so as to give the gun its final range.

Finally, in order to prevent all shocks, it is necessary to provide for the automatic stopping of the turret at the extremities of its movement. This is done by means of a magnetic gear. This provision is necessary in case the gunner is killed or wounded while the turret is revolving at full speed in one direction or the other. The controller does not operate for giving a vertical range to the gun. This is done directly by hand without much difficulty, and is very easily accomplished, as the masses to be moved are almost in complete equilibrium.

Electricity is also employed for raising the ammunition from the magazine below. The power required for this class of work is very small. For a turret containing a 24-centimetre (10-inch) gun, the motor requires 15 horse-power nominally, but it does not normally require more than 10 horse-power, and a 12-centimetre (5-inch) gun turret takes only 3 horse-power.



ELECTRIC GEAR FOR GUN TURRETS.

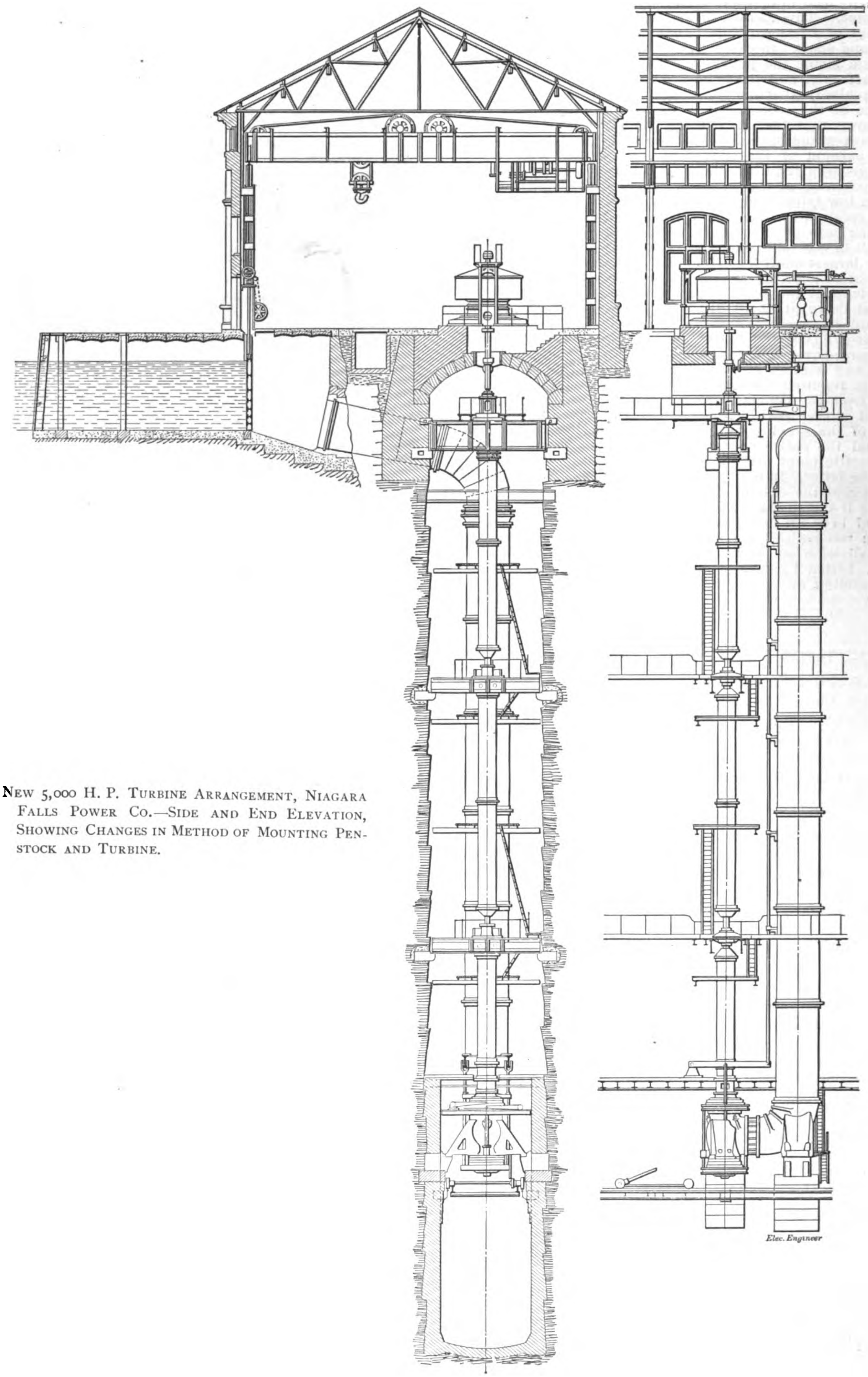
EXTENSION OF THE NIAGARA POWER HOUSE.

BY ORRIN E. DUNLAP.

THERE is much, very much, in the extension of the wheel-pit of the Cataract Construction Company that is of the highest and best encouragement to more than one branch of engineering science, and in addition to this there is still to be found much credit for the men, who, as capitalists seeking profitable investment, or as engineers and authorities, have contributed in any manner to the success which has been attained in making available for the use of mankind a comparatively small, yet intrinsically enormous amount of the force of a wonderful and mighty river. Humanity has perhaps become too matter of fact to stop in this day of electrical and scientific progress to congratulate itself upon the availability resultant from a new development of ideas or power, but on the contrary the present day ambitions of men lead them to contemplate more and more each day the possibilities of the future, and it is this anticipation of accomplishment which encourages and develops new projects and gives greater force to those now under way.

It was on October 4, 1890, that the first sod in the Niagara tunnel work was turned by Capt. C. B. Gaskill, and the few years which have passed since then have witnessed an electrical development which not more than a decade before was almost if not entirely beyond conception. To the success attained at Niagara Falls in this wonderful plant of the Niagara Falls Power Company, electrical, civil and hydraulic engineering owe much. Not that man's ambition did not turn to other water powers, but for the reason that at Niagara the greatest possibilities in the whole world were presented, and where such possibilities are found, there, too, are found the greatest results if success be attained.

It must indeed have been a proud moment for the engineers connected with the Niagara installation, when on the morning of April 4, 1895, Mr. Rudolphe Baumann, a Swiss engineer, moved the small wheel controlling the initial turbine, giving motion to the field of the generators. Since then other turbines and generators have been installed to the full capacity of the

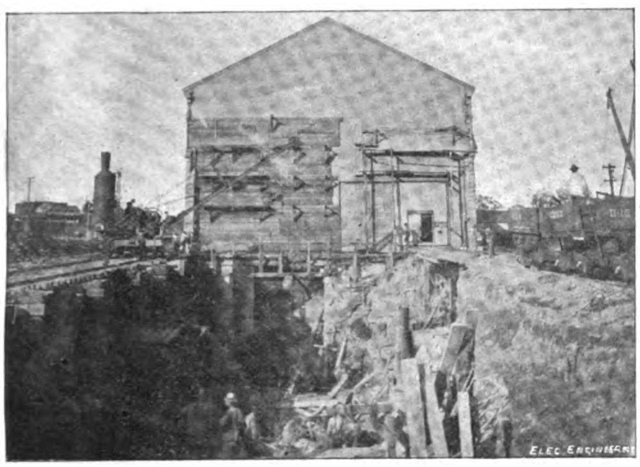


New 5,000 H. P. Turbine Arrangement, Niagara Falls Power Co.—Side and End Elevation, Showing Changes in Method of Mounting Penstock and Turbine.

present wheel-pit and power house, and now a further installation is proposed by the Cataract Construction Company.

The pictures and drawings published in connection with this article well illustrate the scene of the wheel-pit and power house extension, while they also make clear some of the notable changes to be made in the new installation as compared with the present. The contract for the wheel-pit extension is in the hands of E. D. Smith & Co., of Philadelphia, they having sublet the contract for masonry to J. S. Patterson, of Chicago, Ill. Mr. William A. Brackenridge, chief engineer of the Cataract Construction Company, is in charge of the work. Mr. Brackenridge was connected with the original work, and his great familiarity with all parts of the work is invaluable at the present time.

The contract held by E. D. Smith & Co. calls for the extension of the wheel-pit for a distance of 294 feet, making the total length of the pit 434 feet, which will allow room for the installation of seven more turbines, making ten in all in the pit. The depth of the wheel-pit will be 179 feet. The power house foundation will be carried to a point opposite No. 10 inlet, which covers space for the complete power house. It has not, as yet, however, been definitely determined whether the superstructure of the entire power house will be erected, or whether the new portion of the superstructure will only cover the space of three additional turbines. The average width of the wheel-pit will be twenty feet, which is increased at the top to make room for masonry walls six feet wide. The walls are to be carried down to solid rock, the width between them to be 21 feet. One of the changes in the method of construction of this new portion of the wheel-pit as compared with the original portion of the pit is that all the new penstock mouthpieces, seven in number, will be built in the wall, the idea being that when dynamos No. 7 to 10 inclusive are installed, no masonry will be necessary, it having been completed in advance. Still another change is that the openings directly under the dynamos are to be increased. The new method is shown of supporting the girders in the wheel-pit. In the present portion of the pit the girders are built right into the wall, but in the new pit they are to be supported on castings placed in the walls.



Work on Extension of Niagara Power House.

It will be seen that the wheel case and lower penstock elbow will have projecting ribs supporting them on castings without any girders. This is a notable change from the present construction, as girders are used to support the three turbines installed. The supports of the ribs referred to will be bricked into the walls, as is made clear in the illustration.

At present, current exciting the fields of the generators is obtained from 200 kilowatt rotary transformers located at one end of the switchboard structure, but with the completion of the new installation it is proposed to do away with these exciters and four small turbines will be placed in the wheel-pit to operate four exciters located on the power house floor. This change is not because the present method has not proved efficient, but because it is felt the new method described will be in the line of improvement and give an absolutely independent source of supply for the exciters.

A new conduit is provided for on the west side of the power house to carry light and power cables. This will be 7 feet 6 inches by 4 feet 4 inches. The main subway is to be extended. The expense attending the wheel-pit extension will be over $300,000, and it is expected the work will be completed by May, 1897. The alteration in the arrangement of the turbines was suggested by Dr. Coleman Sellers, who is chief engineer of the Niagara Falls Power Company.

The scene of the work is very lively. Messrs. Smith & Company have erected a very efficient plant in order to hurry the contract as rapidly as posible. They have a large force of men at work and good progress is being made. The point of operation is in the rear of the present power house and alongside the inlet canal, as will be seen by the illustration. The method of working is somewhat different from what it was on the original section of the pit. Dynamite is not used in quite such heavy quantities. Channelling machines cut the rock, which is blown out in benches, care being taken that nothing shall occur to injure the installation now doing service. The muck from the excavation is loaded into dump cars and carried over the tracks of the Niagara Junction Railway to the wooden trestle of the same road beyond Echota, where it is used to fill in beneath the trestle and make a firm roadbed. This work of itself will be a notable improvement. The muck of the first section of the wheel-pit and also of the tunnel was used for filling in the company's land under water and thus many acres were reclaimed, on some of which factories to-day stand.

MISCELLANEOUS.

THE TESTING DEPARTMENT OF THE GENERAL ELECTRIC COMPANY'S WORKS.—II.

BY THEO. STRAUS.

THE power for testing is supplied by four engines, three of which are located in building No. 12 and one in the new building. The three in the former consist of one Improved Greene engine, built by the Providence Steam Engine Company, of Providence, R. I., which is a tandem compound. The cylinders are 17½ inches and 28 inches in diameter, the stroke 48 inches and the speed from 60 to 100 revolutions per minute. It is rated at 750 horse-power. The remaining two are Straight Line engines, built by the Straight Line Engine Company, of Syracuse, N. Y. One engine has a 16-inch stroke and 15-inch diameter of cylinder, and the other is of 16-inch stroke with cylinder of 14-inch diameter. Both make 118 revolutions per minute and are rated at 125 horse-power. The engine located under the gallery in the centre of the southern side of building, No. 11 (Fig. 4), is the Lawrence engine, built by Armington & Sims, of Providence, R. I. Its cylinder is 14¾ inches in diameter and it has a stroke of 13 inches, making 260 revolutions per minute and being rated at 150 horse-power.

Steam is supplied to these engines from the central power station, at initial pressures of 120 and 160 pounds per square inch. Belted to the Greene engine is a 4-pole 500 kilowatt railway generator running at 325 revolutions per minute and at 500 volts. Besides supplying power to the different sections of the new building, it runs the two 200 kilowatt 4-pole, 500-volt motors, each of which is belted to the ends of the counter shaft located in the southeastern section of the new building. The shaft being fitted with pulleys of all sizes and

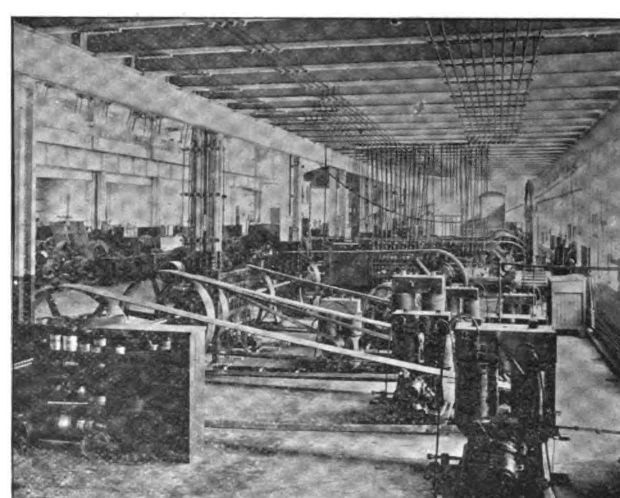


Fig. 4.—The Exciter Plant.

friction clutches, it is an easy matter to connect up a machine and make a test. The two Straight Line engines are also connected to a counter shaft arranged in the same manner. These engines are used in cases of emergency, and are always kept in reserve.

In the Testing Building No. 11, the Lawrence engine is belted to a counter shaft, which runs the exciting dynamo plant. (Fig. 4.) This plant consists of the following apparatus:

Two 4-pole 25 kilowatt generators running at 1050 revolutions per minute, one of 125 volts and the other of 500 volts.

Four 4-pole 17½ kilowatt generators running at 1,100 revolutions per minute, two of 125 volts, one of 250 volts and the remaining one of 500 volts..

Three 30 kilowatt Edison bipolar generators of 125 volts each.

One 45 kilowatt Edison bipolar generator of 500 volts.

These are so arranged that one can obtain any desired voltage from the plant. Although the aggregate horse-power amounts to 1,150, and at times the machines in test have an output over that of the engines, it is seldom the full capacity of the engines is utilized. This is accomplished by the excellent methods and schemes for testing which are used. The principal method for saving power is known at these shops as "pumping back," being an adaptation of the Hopkinson method of testing dynamos. This is carried out by connecting two machines of approximately the same size, so that they will tend to run each other, but having an external supply to overcome all the losses due to friction, hysteresis, eddy currents, slipping of belts, excitation current, etc. To accomplish this, the two machines, one used as a motor and the other as a generator, are belted together, and their armature circuits and that of the loss supply, are connected in parallel. The special part of the test requiring care, is to arrange the conditions suitable for starting. Referring to the diagram, Fig. 5, with the following brief explanation, one can readily see how this is accomplished:

The voltage of the three machines is regulated by rheostats, R, introduced in the field circuits. In the circuit between the loss supply and motor, B, are located an ammeter, A, and starting rheostat, S, and between the motor, B, and generator, D, an ammeter, A, and a switch, C, are connected. The loss supply being brought up to voltage the motor, B, is started. This necessarliy runs the armature of the generator, D, and the machine picks up, generating the field current. The field rheostat, R, is then regulated so that the voltage across the brushes of the generator, D, is about 3 volts higher than that of the motor, B, and the loss supply. When this has been accomplished, the speed being correct, and the voltage across the switch, C, has become about 3 volts, the switch, C, is thrown in, and the machines pump their current back on each other. Then to bring the machines to the required load, the motor field is weakened.

It is not absolutely necessary to use an electric loss supply. In most instances, some mechanical source, such as a countershaft is belted to both of the machines. All types of direct current machines may be tested in this manner by varying somewhat the conditions to suit each case. From actual observation, machines of 2,100 kilowatt capacity have been run at full load, with the expenditure of only 400 horse-power from the engines.

The work at the different shops being so very accurate, it has been found by experience that there is no necessity to put the separate parts together until the machine is erected in

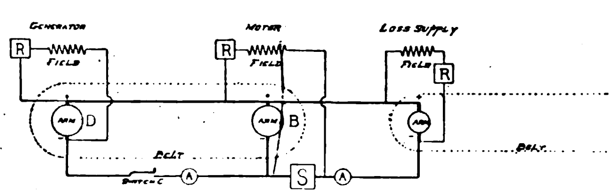


FIG. 5.—METHOD OF TESTING GENERATORS.

the testing building. When a test is to be made, the tester considers the mechanical and electrical parts imperfect and defective until to his own satisfaction he disproves his assumption. A person testing under these conditions is wide awake at all times, and on the lookout for any defects in construction. The testing staff is divided into two classes, the "regular" men and the students. The regular men are those of practical experience, having been with the company for years, and are thoroughly conversant with every machine built by the company. These are ably seconded by the student corps, who, after securing their theoretical education at some college or university come to these shops to gain that important factor in electricit, "practical knowledge." Necessarily the men must be very careful as records of high accuracy only are allowed to pass through the office. The accuracy of the test is doubly insured by the personal inspection of the foreman and engineering corps, and by the frequency with which all the instruments used are calibrated.

A laboratory, used solely for standardizing purposes, is located at the remotest corner of the grounds, far removed from the surrounding buildings. An interior view of this is shown in Fig. 6. It is here that all the instruments used for testing are calibrated and repaired. No instrument is used in a test, if it has not been calibrated at most a few days before.

The instruments are sub-divided, so that only part of them

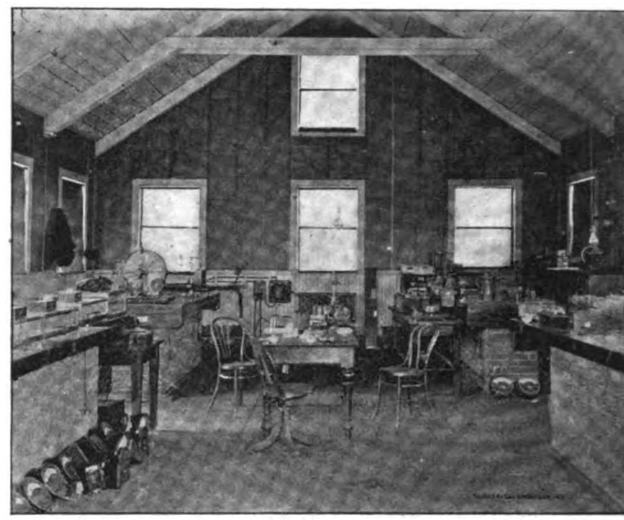


FIG. 6.—STANDARDIZING LABORATORY.

are at the laboratory at one time. Having the curves or constants of the instruments, accurate readings are thus secured and the percentage of error is thereby made very small. The instruments now in actual use amount to 298 and are mostly of the General Electric and Weston types.

These are divided as follows: Direct current ammeters, 85; direct current voltmeters, 80; alternating current ammeters, 40; alternating voltmeters, 20; wattmeters, 25; dynamometers, 13, and tachometers, 35.

A NEW FINDING LIGHT FOR WAR VESSELS.

The French Mediterranean squadron has just made an interesting experiment with a novel light, the invention of a French naval officer. The sailors call it "the rat-trap light." The squadron left Marseilles on the 20th of August, at five o'clock in the evening, leaving behind the torpedo destroyer Faucon, which was to start three hours later and hunt it up. At eight o'clock the Faucon weighed anchor and steamed out in pursuit with all lights extinguished except this novel affair, the ratière. Nobody on board knew the direction the squadron took, but at one o'clock in the morning the Faucon joined it.

This "rat-trap light" is a thing of small dimensions placed in the stern of the vessel above the wheel. No other light is permitted on board. It throws out an electric light which cannot be seen on the right or left of the ship, and can only be discovered dead ahead under certain conditions known to the seeker. By means of this invention night signals can be made when rockets or flash lights might be useless or liable to betray the position of the fleet to the enemy. It can also guide a squadron in line, with all other lights out, even in dangerous latitudes.

The French navy alone possesses this light, and the Admiralty evidently attaches great importance to it, judging by the precautions that are taken to guard it against discovery. The commander of a ship and one sworn officer alone handle it, and it is kept on board in a special apartment, of which the commander holds the key.

TIED ITS HEAD UP WITH A TOWEL.

A reader of The Electrical Engineer reports that as an experiment he recently tied a wet towel on a 16 candle-power 57 volt lamp. It was an old, much blackened lamp. In 22 minutes the towel began to scorch. In 31 minutes the lamp exploded and the towel ignited.

ALTERNATE CURRENT TRANSFORMERS.—V.

BY DR. J. A. FLEMING, F. R. S.

IT will be seen, therefore, that the total Board of Trade units given in the primary circuit in the 24 hours are 68,734, and the total Board of Trade units taken from the secondary circuit in 24 hours are 60,000. The secondary output is, therefore, 87 per cent. of the primary intake, and this is called the all-day efficiency of the transformer on that old diagram. It is not very far from the instantaneous or actual efficiency of the transformer at one-tenth of full load. It will generally be found that the actual efficiency at one-tenth of full load is a very fair guide to the all-day efficiency on a load having a load factor of 10 per cent. One thing that should be noticed in connection with this part of the subject, is that the iron core losses in the transformer are diminished as the transformer heats up. The curve in Fig. 42 shows the results of an experiment with a 50 kilowatt transformer. The transformer was taken up when perfectly cold, and its core loss was measured and found to be 983 watts. This transformer was then connected with the circuits, and the core loss was taken at various intervals during a period of 20 hours, until the transformer had reached a final constant temperature. It was then found that the iron core loss had fallen to 893 watts. The transformer was then disconnected from the circuit, and allowed to cool, observations being taken during that period. After 24 hours the transformer had again become quite cold, and the core loss had risen up to 983 watts. There is, therefore, a difference of 100 watts, or nearly 10 per cent. in the core loss of the transformer when taken hot and when taken cold. This experiment shows the necessity for defining the conditions under which the core loss and efficiency of a transformer shall be taken; it is not enough to specify simply that the efficiency shall be of a certain value. It must be specified under what conditions this efficiency is to be taken, whether with the transformer cold, or the transformer warm. In addition to this

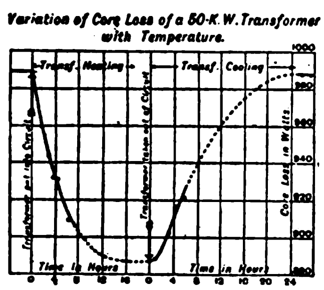


FIG. 42.

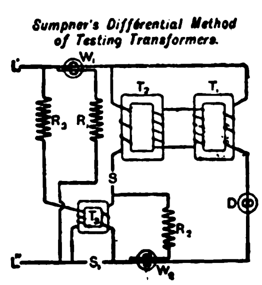


FIG. 43.

there is a variation of the iron core loss taking place with time. When a new transformer, which has never before been used, is connected with the circuits, it is often found that when core loss measurements are made continuously at regular intervals, the core loss goes on increasing, and this may take place to the extent of 40, 50, or even 100 or more per cent. increase. In fact, instances have been noticed in which a core loss has increased in the course of a few months to three times its original value. Mr. Mordey found that he could produce this effect in iron by slow heating. It does not occur in all transformers. In an experiment I specially tried with two new Thomson-Houston 30 kilowatt transformers, which were connected to the circuits night and day for three months, and regularly measured at intervals, no apparent increase in the core loss was found. The reasons for this permanent increase in the hysteresis loss are not yet entirely explained. In the case of some iron which has been very carefully annealed, it is found there is a remarkable rise in the hysteresis loss when this iron was used as the core of a transformer. The same rise is also found in the case of iron which has not been very carefully annealed. We cannot at the present moment state precisely what are the conditions under which this increase in core loss takes place, or what is the constituent in the iron that tends to produce it. It has been supposed by some investigators that the presence of silicon in the iron has a tendency to determine this increase in the hysteresis loss, as the iron is magnetically used. It, however, points to the necessity not only of testing transformers at first, when they are purchased, and before accepting, but of taking a series of tests of the transformer at regular intervals. Suppose that in a sub-station there are three or four large transformers, and that one of these transformers is made the master transformer, and is kept connected with the circuits night and day, the others only being switched on during the time of heavy demand; then it is obviously a very important matter that the transformer, which is thus made the master transformer, should be the one which has the least core loss; and if it should happen that this transformer is one which has largely increased its core loss by use, then it should be exchanged for another which has the least obtainable core loss for that size of transformer. In every substation the wattmeter arrangement described at the beginning of this lecture should be capable of being set up in order to make core-loss measurements in a systematic manner. It is perfectly clear that if a few thousand Board of Trade units more than necessary are being wasted in each transformer sub-station, that the total value of these Board of Trade units when added up and capitalized may realize a very considerable sum of money.

For the purpose of testing large transformers in workshops without requiring a large consumption of power, Dr. Sumpner has devised a differential method of testing, the arrangements of which are shown in the diagram in Fig. 43. In this case the power given out by one transformer on the secondary side is put back into the primary circuit by means of another reverse transformer, so that what is actually taken from the primary mains is merely the total loss in the two transformers. This total loss is measured by a wattmeter arrangement, which enables us to measure, therefore, the efficiency of the two transformers taken together, and, therefore, if they are identical, the efficiency of either of them. In addition to the efficiency tests, there ought always to be a series of security tests to test the strength of the transformer. In the first place, the temperature should be taken after the transformer has been connected to the mains for 24 hours on open circuit, and then connected to the mains for two hours on full secondary load. This temperature is best taken as described in the beginning of the lecture, by measuring the resistance of the copper circuits, but it may be checked by means of a thermometer placed inside the case. Under no circumstances should the temperature in the interior of the transformer rise above 100° C. In the next place, electric pressure equal to double the primary pressure ought to be put on between the primary and the secondary circuits for at least fifteen minutes, and the same double pressure ought to be put on between the primary and case—that is to say, if the transformer works at 2,000 volts on the primary circuit, 4,000 volts should be put on between the primary and secondary circuit for 15 minutes, and 4,000 volts between the primary and case for fifteen minutes. In addition to this, the transformer should be tested for several hours at the normal pressure before being put to work. In the case of large transformers which have stood idle for some time, it is not wise to put on the full primary pressure at once. The transformer should be gradually warmed up by passing a large current through the secondary circuit of the transformer, the primary circuit being short-circuited. In that manner the transformer will be gradually heated up, any moisture which has been absorbed into the insulating material or into the case will be got rid of, and the transformer will be gradually brought into a condition of high insulation. Transformers which have been standing in the stores for a long time may frequently fail if put suddenly on to the working circuits without some such precaution.

OBITUARY.

PROF. LUIGI PALMIERI.

The death is announced of Luigi Palmieri, the Italian meteorologist. He was born in 1807 and began his studies in the seminary of Cajarro. He afterwards went to Naples, where he studied philosophy and natural science. Subsequently he devoted himself to the instruction of young men, and had a private school of philosophy and physics with more than 400 pupils. He was professor of physics in the Marine College at Naples, and afterwards in the University. In 1860 he had the direction of the Vesuvian Observatory. He devoted much attention to electricity and magnetism and for use in the Vesuvian Observatory designed several new instruments, especially two, one for the study of the variations in the amount and kind of atmospheric electricity; another, an electrical seismograph, of which two duplicates have been purchased for use in Japan. Full details of the observations upon the volcanic phenomena of Vesuvius were given in the various reports upon the observatory published by Prof. Palmieri.

HERBERT D. COOK.

Herbert D. Cook, who was drowned at Atlantic City on August 23, was born in 1870, and was graduated from Stevens Institute, in the class of '92. Soon after his graduation he obtained employment as an electrical engineer in the Mermand Electrical Company, of Philadelphia, and had remained in their employ ever since. At the time of the accident he was summering with his folks at Brigantine Beach, near Atlantic City.

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CONTENTS.

ILLIBERAL ELECTRICAL ENGINEERS.

SWEEPING charges and indictments against whole groups of men and even nations are very much in favor with critics of a certain type, and such a man, we take it, must be Mr. R. D. Williams, who writes an article in the "American Machinist" in support of the serious accusation against electrical engineers, that they are wanting in "liberality of mind." They have no generous, give-and-take spirit at all. "Each one seems to think that his own little note book contains the final kernel of truth, which it would be suicidal to disclose, and he keeps it carefully hid in his closet." Sadder, still, this is true not merely between rival companies, but between fellow workmen in the same shop. Corroborative detail proving this deplorable state of things is found in the fact that the electrical journals have a paucity of the kind of correspondence that Mr. Williams finds in delicious profusion in mechanical periodicals. Worst of all, he traces the terrible illiberality of electrical engineers to the fact that they are educated men; while the liberal-spirited, broad gauge, give-it-away, tell-you-how-to-do-it-for-nothing men who spend every moment of spare time in writing helpful, whole-soul letters full of shop kinks, came up from the ranks.

One hardly knows just where to grapple with this kind of indictment. It is somethng like that brought by the Western silver man who assumes that all Eastern folk are in a Wall street conspiracy to squeeze his life blood out of him; or that on which a Spaniard acts when he tears down the flag over an American consulate. The best answer to such prejudice is, perhaps, a little reasoning, but the trouble is you cannot always get the indicter to reason with you. Postulating that Mr. Williams is to be argued with, though he draws the conclusion that education is narrowing, which is not the attitude of a very open mind, we would like to point out to him that as a matter of fact the vast majority of men to-day in the electrical field are not those who have been specially trained as electrical engineers in the schools or colleges. It is far too early for that yet. A great many of them were educated as mechanical engineers, some as civil, but the greatest number came up from the ranks of telegraphy and were not educated at all, in the engineering sense. We live in hopes of seeing the time when the proportion of college bred men in the industry will be larger, and we wish to challenge, as positively as we can, the proposition of Mr. Williams that the percentage now is large or that the educated electrical engineers are a narrow, selfish, jealous lot of fellows. Heaven forbid!

Now as to the contention that electrical men have not a superabundant supply of valuable shop kinks that they want to swap with each other through the medium of a mechanical "mart and exchange" journal. There is something in this, but what of it? Mr. Williams instances bicycle factories, as places where this kind of matter is easy to gather. Our experience of bicycle factories is distinctly to the contrary, and we would very much like to witness his efforts in trying to penetrate into certain experimental departments we have seen. In the electrical field it is peculiarly the case that the arts are new, much is still patentable under the laws of the land, and it costs no little time and money to learn new facts and principles. One of the great reasons why electrical companies and inventors have not reaped a fair reward is that they were not able to protect themselves after years of effort and expenditure; but Mr. Williams would apparently let the bars down altogether and abolish the patent system, so far as electrical engineers are concerned. Mr. Edison dealt with this very subject the other day when he said: "I discover a great many things I would be glad to give to the public for nothing, but I don't dare. I patent these things to save myself from defending lawsuits. There are a lot of sharks in this world who are continually on the lookout for new things, and when one of them hears of something new he hustles to the patent office to see if it is patented. If it isn't, he claims it as an original dis-

covery and files his claim. Then he will turn right around, and, like as not, begin a suit with the man who invented the thing for making use of it. The inventor will say: 'But I discovered this thing first; I am the inventor.' He is referred to the patent office, where he finds the official claim of original invention. The fact that the papers are filed long after he made his discovery does not help him, for all the other man does is to hire a fellow to swear that he made the discovery a month or two prior to the date the inventor claims. It sounds ridiculous, probably, but it is a fact that there are often races between the inventors and the sharks to reach the patent office, the sharks having had early information about the inventor's discovery. There are many such races, and thousands of dollars depend on each one. What I say is literally true."

Mr. Williams might reply to this that he was attacking, not inventors, but electrical engineers. It makes no difference. A professional man does not slop over all the time in letters to the journals. Architects, civil engineers, lawyers, doctors, and others, are not by any means more communicative than electrical engineers, if as much so; and they would object, as we do, to any test of a man's liberality of mind, based on his readiness to unload "hints" and "kinks" and "wrinkles" and "chips" from his own experience, for common consumption.

In conclusion, it is but fair to electrical engineers to mention a fact with which Mr. Williams may not be familiar, but which is highly pertinent. A great many electrical engineers are in the employ of large corporations, and are not at liberty to divulge what they learn in the factories or laboratories, or to publish news as to novelties. In numerous instances they are under contract to convey to their employers any new invention they may make. This system is not peculiar to the electrical industries, nor is it in them limited to the factories. The telephone and telegraph companies are willing to allow their skilled men to take part in ordinary discussions, but have a well understood and rooted aversion to the printing of any of the methods and apparatus they have made their own. We think that this policy might sometimes be more liberal, but it often has warrant, and it is at least certain that the electrical engineers are not to blame for it.

NEW YORK STREET RAILWAY CONVENTION.

It is a sad thing to contemplate that companies engaged in a legitimate industry, catering to a public want, and furnishing service better and cheaper than has ever been done before in the history of the world, should be compelled to band together for the purpose of resisting unjust encroachment on their rights and privileges from the Legislature selected by themselves and their patrons. Yet such is the fact, and the result has been the organization of electric light and electric railway State associations, most of which have attained vigorous growth. Among the latter the New York State Street Railway Association, which held its annual meeting last week, is one of the most active and valuable to its members, as will be apparent by a glance at the papers and proceedings of the Binghamton convention, which we publish in this issue. Organized primarily for protection against legislative "strikes," the mere fact that during the last session of the New York State Legislature 140 bills relating to street railways were introduced, is sufficient proof that the association has a raison d'etre to an eminent degree, and plenty of work to do to ward off the animosity or cupidity of dishonest Assemblymen against railway, telephone and other public corporations. The work accomplished in this respect by the association's officers and counsel in the past year has been well rewarded. But outside of the work of self-defence in which these State organizations are engaged, the meetings also, as a rule, serve to bring out papers and discussions on railroad management and operation which are of the highest value, and this last convention is an eminent example of the usefulness of such an association to its operating members. Every paper read contained one or more valuable suggestions, and several contained information of the highest practical value. Take for example that by Mr. F. O. Rusling, on the use of old rails as underground conductors. There is scarcely a road of any size which has not from fifty to several hundred tons of old rails in its scrap pile, and one can hardly imagine a better use for them than as conductors to supplement present feeders. The cost as compared with copper is largely in favor of old rails. As regards the question of resistance at the joints that seems also to have been satisfactorily solved, according to the experience of Mr. Rusling, so that unless the lapse of time should develop some change in the present condition of the work done by him, the old rail may yet figure as a prominent and useful factor in electric railway work.

Passing from old to new rails, Mr. C. S. Allen in his paper points out the very important position which the high-carbon rail is destined to occupy in street railway work, as well as in steam railways. The tests which he mentions as having proved satisfactory on the New York Central have been confirmed by a similar one of street railways in Brooklyn and elsewhere, so that there is little doubt of the manner in which many future specifications of street railway rails will read.

Probably as important a question as any of those brought before the convention was that relating to the distribution of power from trolley circuits. Waiving the objections raised to this form of distribution by the Fire Underwriters, the author of the paper aims to prove that power can be distributed more cheaply from railway circuits than from electric light and power circuits. We believe this to be an open question. If the author meant to compare the efficiency of generation possible with the modern high class apparatus installed in street railway stations, with the older and less efficient apparatus in the many electric light stations, without taking into consideration other items, it would be conceded that the comparison would be in favor of the electric railway. The electric railway, it is true, has the advantage in the ease with which connection can be made to its conductors, when these are overhead, as they are in the majority of instances. The distribution of power is a development which railway companies should go about very deliberately. Nothing, we take it, ought to be allowed to interfere with the operation of the road by any company having its own interests at heart. While it is true that there are in most cities periods of light loads at the station, a great many conditions arise to put full or abnormal loads on the system, aside from the regular periods of full loads. At such times any extraneous load, such as that from power motors, would be a drag on the system, and would, in all probability, occasion a breakdown, or, at least, a serious interference with the regular operation of the road. Then, again, we think it is rather the rule than the exception that railway feeders are not made any too heavy for their work, and hence even if made sufficiently heavy to carry the normal full load there would be nothing to spare to carry the stationary motor power load which might be connected to the circuit. It is here that we believe the most serious trouble will be found. There may probably be instances where small roads might derive a profit from such a stationary motor service, but we are pretty certain that no large company valuing the character of its service can afford to undertake this class of work. We have, of course, not touched upon the legal aspect of the subject as to the right of street railway companies to enter into this class of business, but aside from that, it would be better on all accounts for street railway companies to leave this work to those to whom it naturally belongs, the electric light and power companies. We believe a good deal of friction and unpleasantness will be avoided by adopting this course.

A COMPRESSED AIR CAR.

Just before his departure for Europe, M. Abdank-Abakanowicz, who has been over here from Paris studying the street railway situation, was interviewed by the "Evening Post," when he made statements as to compressed air traction in his own country, confirming the intelligence on the subject received by ourselves. He said: "I confess that I did not examine the cars you have in operation here on One Hundred and Twenty-fifth street; but the reason is that, as an engineer, I have studied the principle thoroughly and know that it is incapable of any substantial development. So far as I have heard, the only difference of any moment between the air motors here and those in France is that here you propose to operate under a very much higher pressure of air than we use there. But this, while not increasing the efficiency of the system to an adequate extent, and not removing the objections founded upon complexity and cost, is highly dangerous. With the much lower pressure used in France we have had many accidents. Tanks, pipes, and valve-boxes have at one time or another exploded. I have personally seen two explosions. What would be the result with the pressure doubled? Since the practicability of the trolley was demonstrated there has not been a single compressed air line added to those already in France." It is understood, we might add, that the cost of compressed air operation in Paris has also been enormous.

It does not follow, however, that Paris will have the trolley, except in outlying districts, any more than it will resort to the cable, which M. Abdank considers also as doomed. Hence we may look for some underground conduit work in Paris, and perhaps storage battery cars, though they are not in favor there. The fact that the omnibus monopoly in Paris expires at no distant date, when a new contract with the city will be necessary, will without question inaugurate a new regime of mechanical traction in that city, when electricity will "be in it" very emphatically.

Roentgen Rays.

THE PHYSIOLOGICAL EFFECTS OF THE ROENTGEN RAYS.

BY H. D. HAWKS

IT seems that all of the properties of the X-ray have not yet been discovered; among the latest is the physiological effect. With the powerful apparatus now used, experimenters are beginning to find that it affects the system. During the early part of July I carried on a long series of experiments with an extremely powerful apparatus. At the end of a few days I found that the rays were having quite an effect upon me. At first the skin began to dry and to itch, all the moisture being taken out of it; I paid no attention to this, but continued to work. After a little longer exposure my hand, which was the part most exposed, began to swell, the inflammation being in the hand for about ten days; at the end of that time the swelling rapidly went away, but the skin all came off, just as with a sunburn. The joints and finger nails seemed to suffer most, the joints becoming nearly transparent, and the nails killed, as new nails have since grown. Wherever the hair was exposed to the ray it fell out, but it does not seem to be permanently injured as it grows again as the skin gradually returns to a healthy condition, but the growth is very slow. In my case it was eight weeks after the exposure before it started to grow. The eyes were also very badly affected, where not covered by the lids. The exposure to produce such effects as these probably amounted to between two and three hours.

As to what produces the burn, I think it is purely an electrical effect, and that the ray has nothing to do with it, except in a peculiar manner; the burn is such as would be produced by a combination of heat and light, as sunburns. Now the light is supplied by the ray, and the heat, I think, is due to electrical conditions, that is, there may be an invisible electrical shower that comes from the tube, the air may be full of very small electrical sparks that we do not perceive in the ordinary light, but as the room is darkened we can begin to see this shower. Anyone that has held his hand before a tube has experienced the same sensation as when the hand is held near a high potential electrode, and if held close and the room is dark the shower of sparks can actually be seen. As far as I have experimented, any electrical conductor placed on the hand will prevent the burning action.

Summing up I will say that the effects seem to be confined to the skin alone, and consist principally in the drying up of the oils in it, which produces all of the effects on hair and nails as noted, and none of these effects are permanent, but disappear when the skin becomes healthy again.

LODGE ON ROENTGEN RAYS.

The mode by which light and Röntgen rays are able to bring about the discharge of an electrified surface has been discussed by Dr. Oliver Lodge in "Science Progress." Experiments were carried out by him with the object of testing the presence of metallic particles or vapor near an electrified metal rapidly discharging under the action of light. The results lead to the conclusion "that the discharge of electricity from illuminated surfaces is not effected by evaporation of those surfaces, but that the molecules, which convey the charge, belong to something in the gas, and not to the illuminated body." It is suggested that the discharge of an electrified surface by Röntgen rays—an action which seems to be brought about by the conversion of the gas, or other insulating material, near the charged body into a conductor—is probably effected "by dissociating the substances into charged atoms which are then free to act as carriers, and speedily convey to a distance the charge of an electrified body by journeys along the lines of force. It may be that ultra-violet light acts in somewhat the same way, but not in exactly the same way." As to the nature of the rays, everything now indicates them to be transverse vibrations, and Dr. Lodge thinks their wave-lengths are not much greater than the size of atoms.

X-RAY PHYSIOLOGICAL EFFECTS.

With regard to certain features of X-ray physiological effects, Mr. G. A. Frei, of Boston, writes us: I am inclined to think that a continuous application of from one to two hours will start the effect. In my case it was an application of about 10 or 15 minutes a day for about a week before I could notice the effect. At first the skin becomes brown the same as sunburned, then the hand begins to swell and the color turns blue. In my case water blisters were raised, one of the ⅜-inch diameter. At times there is a burning, itching feeling for a few minutes then the pains disappear again. The swelling increased for several days till I decided to stop experimenting on my own hands. I had sufficiently demonstrated the effects of the rays as far as I was concerned. Three or four days after I stopped it began to improve. The skin peeled off; I should say I took off three layers. At that stage I was obliged to test three tubes and thoughtlessly I exposed the same hand for about a minute or a minute and a half. This completely stopped all improvement for a number of days. At present my hand is nearly in good condition again. It would undoubtedly be interesting to know what the ultimate result would be, yet I do not care to use my own hands for the experiment, especially as a hand showing the X-ray treatment is not a thing of beauty."

EXPERIMENTS WITH ROENTGEN RAYS.

ACCORDING to telegrams in the daily papers, at a psychological congress at Munich there has been a Röntgen ray demonstration, at which a "living human body (why not say a man and save two words of the telegram) was placed under the action of the rays," and observers were able to watch the action not only of the osseous parts of the body, but also of the diaphragm, stomach, and heart. How it was done is not said, except that it is mentioned that "specially prepared tubes" were used. Probably higher vacua than usual and an extra high voltage were adopted. In this connection it would be interesting to know what is the precise effect of using anodes of less density than platinum on the penetrating power of the rays and varying the nature of the residual gas in the tube. The latter ought to have a very considerable influence on the result, but it must be remembered that though theory may give some hints as to the way to get a particular kind of wave length, there is also the question to be considered of whether the fluorescent screen or the photographic plate will respond to it. Lastly, it has been gravely announced that a discovery has been made—and made in Germany, though not at Munich—that the aurora borealis is caused by Röntgen radiations emitted from the sun making the air fluoresce. That the aurora is seen at night does not seem to have occurred to the discoverer. It is really quite remarkable how a subject like the new radiations, which obviously required in anyone dealing with it some acquaintance with the conceptions of physics, should from the beginning have been selected as a happy hunting-ground for that numerous class of people who, being without clear ideas in the matter, are as fertile in suggestions as they are incapable of understanding the experimental proofs of their futility. But perhaps even this is not more remarkable than that the really eminent persons who interested themselves in the subject did not sooner see that phenomena which were as familiar to them as their alphabet were entirely fatal to the original hypothesis of longitudinal ether vibrations.—London "Electrical Engineer."

Letters to the Editor.

THE THREE-WIRE PATENT IN THE U. S. AND ENGLAND.

We learn that the three-wire Edison patent has expired in England. Should this information be correct, will not such expiration have effect on the patent's life in this country? We would be very glad to receive any advice on this subject.

Sept. 2, 1896. THREE-WIRE.

The three-wire patent which expired recently in England was that issued to Dr. John Hopkinson. So far as we are aware, no foreign patent on the three-wire system was taken out by Mr. Edison prior to the U. S. patent, and hence the U. S. patent is in nowise limited by the foreign patents.—Eds. E. E.

Patent Notes.

U. S. PATENT OFFICE STATISTICS.

A total of 24,585 patents granted and trade-marks, labels and prints registered by the government during the year is shown in the fiscal year report of the Commissioner of Patents, submitted to Secretary of the Interior Francis this month. Of these, the patents, including reissues and designs, numbered 22,791, and trade-marks 1,782. There were 48,105 applications received, 41,668 being for letters patent alone.

The number of patents which expired was 11,166. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 4,014. The total receipts were $1,307,090, the receipts over expenditures $209,721, and total receipts over expenditures to the credit of the patent office in the Treasury now amounts to $4,776,479.

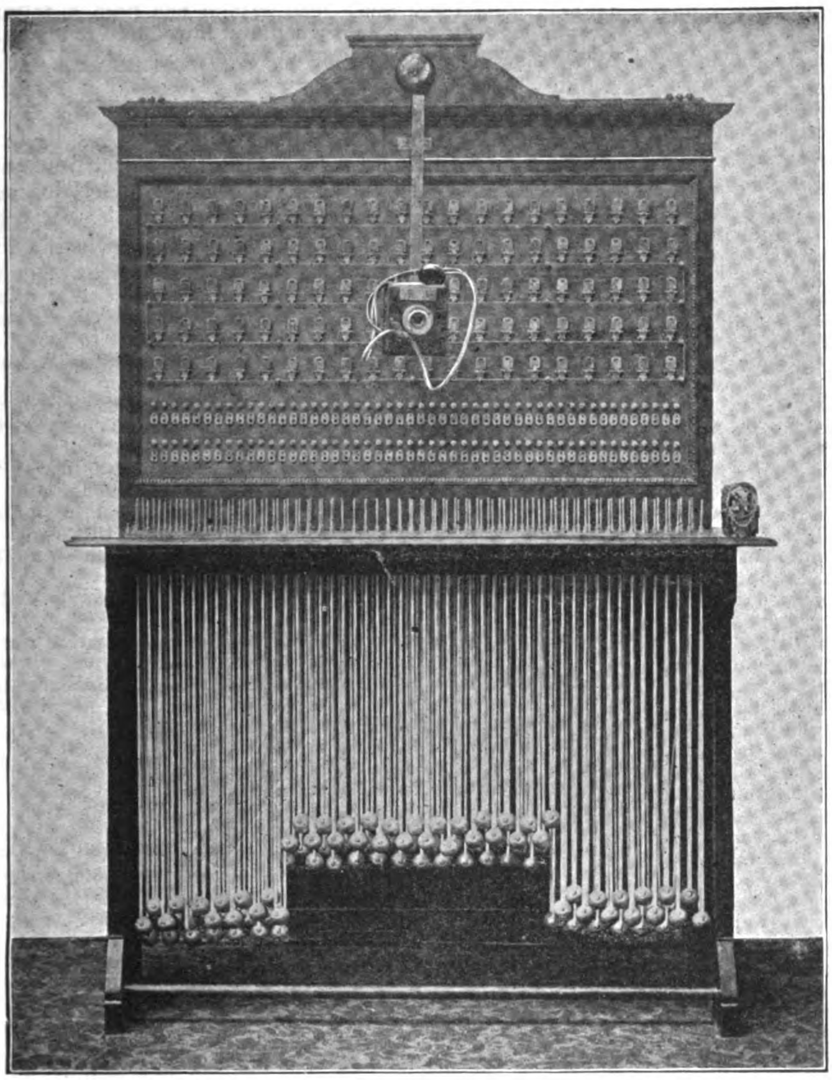
TELEPHONY AND TELEGRAPHY.

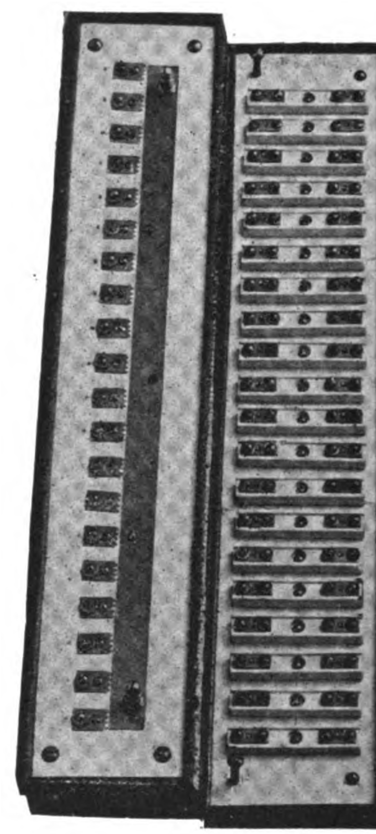
THE MISSOURI TELEPOHNE MFG. CO'S. IMPROVED SINGLE PLUG SWITCHBOARD AND LIGHTNING ARRESTER.

THE accompanying illustration, Fig. 1, represents an improved central telephone station switchboard, invented by Mr. E. L. French, superintendent of the Missouri Telephone Manufacturing Company, St. Louis, Mo. The most striking feature of the board is the large number of plug cords. Each subscriber has a drop, and the continuation of the drop to complete its circuit has a plug cord. The base of each plug is a brass button, which is pulled down tight to brass bars running across the switchboard table, and by the aid of the lead balls, which have a hole through them, threaded on a sistance and serves as a clearing out coil when the two subscribers are through talking.

The jacks used in connection with this board are extremely simple. The plug breaks the connection from the drop to the plug cord. The plug holes, which are on the face of the board, are all shunts, and when any plug is inserted in any plug hole it has a direct connection to the line without going through any coil. Another important feature is the easy adjustment of this board. Mr. French claims that he can place a 200 drop switchboard in a space 6 feet wide and leave plenty of room for renewals and adjustment. This board is said to possess other mechanical and electrical improvements, which render it very efficient for quick and accurate service.

The illustration, Fig. 2, represents the company's switchboard lightning arrester, which is claimed by the manufacturers to positively protect the apparatus against damage from high-tension electrical currents as well as against lightning.





FIGS. 1 AND 2.—SWITCHBOARD AND LIGHTNING ARRESTER, MISSOURI TELEPHONE MANUFACTURING CO.

spiral-braided plug cord, the current travels its course to the ground. This feature, of having one plug cord for each subscriber, is claimed to be an important improvement. Each plug is numbered, and the operator with a little experience can familiarize herself, and quickly lay her hand on any plug desired.

When a subscriber desires a connection the operator takes the plug corresponding to the drop and touches it to the operator's bar, which is a long brass bar running the full length of the table of the switchboard. This throws her receiver and transmitter in circuit with the subscriber, and she finds the number desired; then by simply inserting the plug in the plug hole of the number called for, the connection is made. When the plug is inserted it cuts out the drop coil of the subscriber and leaves only one coil cut in on the line between the two subscribers conversing. This coil is wound with very low re-

In its design and construction one of the most important objects aimed at was to so distribute the wires that any one could be readily accessible without interference with any other.

The framework of this arrester is constructed of hard wood, and is painted with an insulating compound, which renders it an insulator itself. On the face of the board are mounted the fuse blocks, and the lightning jaw teeth are protected with ¼-inch asbestos. The line wires run direct to the fuse blocks, thence to the switchboard. Each wire is tapped for connection with the lightning arrester, the terminals of these tap wires being represented by the line of serrated brass jaws, which are set 1-16th of an inch from the ground bar. By this arrangement the lightning discharge will jump the space between the teeth and the ground connection.

The fuse blocks afford protection against high-tension cur-

rents and are not designed to avoid the damaging effects of lightning, the lightning arrester taking care of that. The two systems of protection, however, give a combination on one switchboard, that is claimed to be absolutely reliable in its action. The Missouri Telephone Manufacturing Company has equipped some of the largest exchanges in the United States with these boards.

The board is simple in construction and durable, and the company maintains it in working condition. It is stated that operators in exchanges equipped with these boards have so much confidence in the apparatus that they do not leave their seats at the switchboard during thunderstorms, as is frequently done in exchanges having the ordinary protective devices.

The Missouri Telephone Manufacturing Company will have a display of its apparatus on the main floor of the St. Louis exhibition this year, and informs us that it is the only electrical concern that has been admitted thereto.

A PLEASANT PICTURE OF PROF. BELL'S COUNTRY LIFE.[1]

BY GRANT HAMILTON.

EVERY summer a great many American tourists "discover" Baddeck, and every one of them is surprised to find that Baddeck was enshrined in American literature twenty years ago by Charles Dudley Warner. He is still more surprised to find that one of the best known citizens of the United States—a man whose name is on every tongue—has an estate in Baddeck of magnificent proportions and spends there in cool content the summer months.

Baddeck is a sleepy old village on one of the chain of lakes which connects upper and lower Cape Breton Island. Bras d'Or Lakes they are called. Many of them are rather arms of the sea, reaching in from the coast near Sidney in long, narrow strips, which broaden through slim estuaries into beautiful lakes dotted with pretty wooded islands.

It was on an exploring trip through the lake region that Professor Alexander Graham Bell, the telephone inventor and millionaire, found Baddeck six or seven years ago. He was traveling with Mrs. Bell and her parents, Mr. and Mrs. Gardiner H. Hubbard. They stopped at quaint Baddeck, became fascinated with its quiet, its simplicity, its beautiful surroundings, and Mr. Bell determined to make it his summer home.

Mr. Bell does not do anything by halves. Admiring the mountains about Baddeck, he bought one and created an estate on which he has spent not less than $250,000 on improvements. Roads have been laid out, making magnificent drives, and a $35,000 house has been erected. It is a double house of frame, from which a great brick chimney rises, telling of a big fireplace and a generous log fire in the reception hall. There is a tower at each corner, and across the whole of the broad front stretches a veranda. As far as the eye can reach from this veranda stretches a panorama of mountain and valley and lake. Cool breezes blow across the mountain all the summer days, and every night is cold enough for fires and blankets. For neighbors Mr. and Mrs. Bell have George Kennan, the Russian traveler, and his wife, warm friends of theirs. For company there are many friends, to whom both the Bells and the Kennans extend a hearty hospitality. For occupation there are sports in season, the beautiful drives around Mr. Bell's thousand acre estate and work in the laboratory which Mr. Bell has built.

Mr. Bell calls his estate Beinn Bhreagh. A tugboat brings it in communication with Baddeck, and also furnishes the motive power for the houseboat, Mabel Beinn Bhreagh, named after Mrs. Bell, in which the Bells make frequent tours of the lakes. In the shooting season Mr. Bell and Mr. Kennan occupy a pretty little hunting lodge twenty-five miles inland. Very near Baddeck is the Margaret River, one of the finest salmon streams in the provinces. There is no lack of sport when the season opens, in the middle of September.

All the days are calm and peaceful in Baddeck. Farming, fishing and sheep raising are the chief occupations of the people of this country. There are no factories or saw-mills, and the few stores in the little town have a sleepy look. But it is less sleepy than it was in Mr. Warner's time. The Bells and the Kennans have labored earnestly to improve the condition of the people. Mrs. Bell has had teachers and materials brought from Boston to teach the wives and daughters of the fishermen to make lace, like the peasants of that older Breton in France. Mr. Bell has helped open a sale for the carpets which these women weave. A kindergarten school has been established through their efforts. There are classes in literature, and a current events club for the wives and daughters of the merchants of the little town. For the men Mr. Bell has founded a workingmen's club and Mr. Kennan a free library. Communication between the farming region and the lakes has been made easier by the roads Mr. Bell has built, and altogether the country about Baddeck is more prosperous and happier for the coming of the wealthy inventor.

[1] Abstract.

BELL TELEPHONE OUTPUT.

It is said that the instrument statement of the American Bell Telephone Company for the month ending August 20 has not been favorable, many instruments having been returned. The cause of the large gain in instruments outstanding the past six months, nearly 125,000 increase, is said to have been due largely to the change in the method of telephone charges, the introduction of the party line and the measured service systems. The party line system has not been a complete success, except perhaps in the suburbs. Its principal disadvantage is the continual ringing of the telephone bells in houses, two to five residences being on the same line, and the natural mistakes arising therefrom. The system has been a failure in Boston, it is said, although when first introduced it was largely adopted by physicians and attorneys.

THE KILDISCHEWSKY TELEPHONE.

A special dispatch from London, of September 8, says: The "Daily News" will to-morrow publish a dispatch from Odessa saying that M. Kildischewsky, an electrician, has discovered an improvement in the telephone by the use of which distance has no effect upon the hearing. In a recent experiment between Moscow and Rostoff, on the Don, a distance of 890 miles, talking, music, and singing were heard with perfect distinctness. An ordinary telegraph wire was used. The dispatch adds that M. Kildischewsky will go to London to experiment with his improvement on the Atlantic cables between London and New York.

Commenting on this, Mr. F. A. Pickernell, the engineer of the American (Long Distance) Telephone and Telegraph Company, said:

"I see it is stated that he has talked over 890 miles of wire. Why, here in this country we have a telephone circuit 1,400 miles long in commercial use every day, and I have talked over 2,200 miles, nearly three times as far as this man. The line he experimented on is really a very short one, and I see nothing in his achievement to boast of."

"But he used an ordinary telegraph wire," suggested the reporter.

"Well, we use copper wire, exactly the same as that used by the Postal Telegraph people for their main lines. I would be the last man in the world to seek to minimize another's invention, or to say it is worthless. But there is nothing in this account to indicate that he has anything of importance. He has probably got a new transmitter and thinks it beats the world. Now, I have made telephony my life work, and am not exaggerating when I say that Americans are far ahead of Europe in long distance work. I designed the line from New York to Chicago, which was twice as long as any then in use, and to-day our line from Boston to St. Louis, 1,400 miles long, is more than twice as long as any European telephone circuit. Our line to Memphis is 1,588 miles long. These lines are in commercial use, and people pay their money to talk over them, while the Russian's 890-mile line is only an experiment. The foreign governments owning the long distance telephone lines in Europe in fact have adopted American methods and plans for operating them."

"Do you consider it feasible to telephone across the Atlantic?"

"All experiments indicate that there is no possibility of this. I made some calculations once and found that it would be necessary to have a cable as thick as a hogshead to carry the voice so far under the ocean. The Lucania, Campania, and all the big steamers couldn't lay such a cable, even if it was made, and the cost would be several hundred times that of an ordinary cable. The telephone line from London to Paris is the one they boast of in Europe. It is 290 miles long and has 20 or 21 miles of submarine cable. I have talked over 23 miles of submarine cable. It was on a government cable and the line connected Nantucket and Boston. That is about the limit of successful submarine telephony."

KNOXVILLE, TENN.—According to the Knoxville Morning "Tribune," the local People's Telephone Company, which makes its own equipment and pays no royalties, now has 600 paying subscribers on its list, and is reaching out into the country with the intention of connecting up points 100 miles distant. The officers are: C. E. Lucky, president; W. L. Welcker, vice-president; J. C. Duncan, general manager; F. J. Milligan, secretary and treasurer.

ELECTRIC LIGHTING.

A SUBSTITUTE FOR SHUNTS AND MULTIPLIERS ON WATTMETERS.

BY B. D. FRANKENFIELD.

A GREAT deal has been said about shunting the current coils of wattmeters and using multipliers in series with their pressure coils, to increase their measuring capacities. There is another method which others than the writer have, no doubt, originated and used, but which he has never seen in print.

Suppose we have two or more wattmeters of small capacity. Connect their current coils in parallel and their pressure coils in series. Let the current capacities be C_1, C_2, C_3, etc.; the pressure capacities, V_1, V_2, V_3, etc., and let the resistances of the pressure coils be R_1, R_2, R_3, etc. Let the angle of lag between pressure and current be ρ, and suppose that the instruments are all of negligible time constant. We now have a system with a current capacity and a pressure capacity equal to the aggregate current and pressure capacities of the individual meters, but the number of watts it will measure is greater than the aggregate as is shown by the following equation:

$$\text{Maximum watts} = C_1\,V_1\frac{R_1+R_2+R_3}{R_1}\cos.\psi + C_2\,V_2\frac{R_1+R_2+R_3}{R_2}\cos.\psi + C_3\,V_3\frac{R_1+R_2+R_3}{R_3}\cos.\psi.$$

When the meters of the system are all alike the equation becomes

$$\text{Maximum watts} = n^2\,C_1\,V_1\cos.\psi$$

where n is the number of instruments in the system.

For direct current work or for resonant alternating currents, the term cos y becomes unity, and the equations are then:

$$\text{Maximum watts} = C_1\,V_1\frac{R_1+R_2+R_3}{R_1} + C_2\,V_2\frac{R_1+R_2+R_3}{R_2} + C_3\,V_3\frac{R_1+R_2+R_3}{R_3}\text{ etc.,}$$

$$\text{and maximum watts} = n^2\,C_1\,V_1$$

This method can be used with as many as three wattmeters, but with a greater number would be cumbersome. So far as current affects the readings, it is as accurate as a single shunted wattmeter calibrated with its shunt, and, in some cases, more so. If the instruments are unlike and the scales not uniform, errors of personal equation are liable to have less effect on the total energy measured, and if the observer reads one instrument too high and another too low, as might be the case with a direct reading instrument, such as the Thomson or Weston, coupled up with a zero instrument, like the Hoyt or the Siemens electro-dynamometer, the errors of personal equation would be compensating.

So far as pressure affects the readings, each pressure coil acts as a multiplier for the others and an error in reading would be multiplied just the same as in the case of a single meter with a multiplier. The graduation of the scales might here be a consideration as well as the types of wattmeters used. When like instruments are used, a very accurate determination can be made by averaging the corrected readings and multiplying by n^2.

This method can be used with shunted instruments or with a single shunt around the whole system, but the corrections would be complicated. However, it might sometimes be convenient to use a multiplier in series with the pressure coils when testing on voltages higher than the aggregate voltage of the instruments.

Here is an illustration of the convenience of the method: There are two wattmeters in a certain laboratory, each of 110 volts by 10 amperes, and the aggregate number of watts they will measure is 2,200 on a circuit whose power factor is 100 per cent. It is desired to measure a power of between 2,200 and 4,400 watts on a 220 volt circuit. Connect the current coils in parallel, the presurse coils in series, and you have it. If the instruments are alike multiply the average of the corrected readings by four; if not alike, measure the resistances of the pressure coils and correct as in the above equations.

A STANDARD SYSTEM OF LETTERING AND ARRANGING CIRCUITS.

BY JAMES H. BATES, M. E.

THE crucial problem of the construction and maintenance of plants is that of easy and quick handling of circuits—for repairs and renewals more than for installation.

This, it has always seemed to the writer, might be more systematized than it is even in the case of the most common systems of distribution, namely, continuous current two or three wire and single phase alternating current systems. In other words, there should be a fixed standard method for all kinds of systems, for this in the case of circuits of more than two wires (such as in polyphase alternating and four, five or more wire continuous current systems now coming into use) will soon be indispensable.

This article is to suggest how easy such a matter can be in spite of any apparent complication. To start with, let us take the two-phase alternating system with its four wires. Here one has only to call the poles of the dynamo and the conductors therefrom A, B, C and D, and to have the maker so mark wires that a workman will at a glance know whether a wire is an A, B, or something else. There are many methods of marking possible, but the best probably are the two following: 1. A different braid or tape for each letter. 2. A stamp for the lead cover such as a letter at convenient intervals.

In the case of other systems mark as follows: Alternating system, single-phase, A and B; three-wire two-phase, three-phase and monocyclic, A, B, and C; continuous current systems, four-wire, +, B, C and —; five-wire +, B, C, D and —, respectively, from extreme positive conductor to extreme negative one. To still farther simplify matters arrange the wires vertically, A over all, B, C, etc., in regular order below. This can be represented graphically by the accompanying table in which the space containing the letter or sign represents a duct under ground or air space overhead.

Continuous Current Systems.				Alternating Current Systems.		
2-wire.	3-wire.	4-wire.	5-wire.	2-wire, 1-phase.	4-wire, 2-phase.	3-wire, 2-phase, 3-phase and monocyclic.
+ —	+ ± or B. —	+ B. C. —	+ B. C. D. --	A. B.	A. B. C. D.	A. B. C.

LITERATURE.

MODERN EXAMINATIONS OF STEAM ENGINEERS.—By W. H. Wakeman. New York, 1895. American Industrial Publishing Co. 272 pp.

This book is written with the object of giving information to those engineers who wish to qualify themselves to pass the examination required for taking out license to run stationary engines in localities where licenses are required. The work is divided into 53 chapters, which, after giving a general outline of the requirements for the several classes of licenses, take up the various parts of the steam plant which are treated from a practical standpoint. Beginning with the steam engine the values are first discussed and the following twelve chapters explain in a clear manner the various parts of an engine, how they should be designed, adjusted, etc., and also the various types of engines. This part of the book contains numerous numerical examples of the calculations of various parts, horse-power, weight of flywheels, and other essential factors of an engine, which puts the subject before the reader in a manner that is easily understood.

Under the subject of boilers, the safe working pressure, strength of seams, bracing and other requirements are treated and mathematical examples are given. After covering the subjects of piping, exhaust steam heating, strength of materials and other allied subjects, the book concludes with 300 practical questions in regard to the matter contained in the text, with references to the pages where the answers are to be found. The information contained in the book will prove very useful for engineers desiring to pass the examinations required to obtain licenses.

ALDEN'S LIVING TOPICS CYCLOPEDIA. New York, John B. Alden. Price, 50 cents per volume.

The bound volumes of Alden's Living Topics magazine are published under the above title, and an appendix at the close of each volume includes important items preceding close to the date of publication. The scheme of the book is quite novel and consists of a brief and concise treatment of the topics and persons of the day. It covers a wide range of subjects, but makes a special feature of biographical information and modern events of general interest. As it contains only current material, the desirable information it offers is thoroughly up to date.

ELECTRIC TRANSPORTATION.

RATING OF ELECTRIC RAILWAY APPARATUS.[1]

BY W. J. CLARK.

WE all know that in street railway operation there is not the necesity for the full and constant study of the standardizing rolling stock that is being carried on by the master car builders and master mechanics of the steam roads. But in the practical operation of a street railway different conditions exist from these met with in the operation of a steam road, so you must view the special features of your business from a different standpoint than they. Unquestionably it would operate to your advantage, as it would most certainly to the electrical manufacturer, if some definite positive rule for the rating of all of the electrical apparatus were fixed. It makes but little difference what this basis of rating is, provided it is universal, well understood and thoroughly insisted upon by street railway men; and I wish to be distinctly understood as not advocating the particular method of rating which has been followed by the corporation which I represent, but I do most emphatically place myself on record as being in favor of some system to be evolved through the wisdom of the street railway fraternity, and based upon such methods as may seem most just to them, which will fix definitely what a motor of, say, 25 horse-power or 800 pounds tractive effort is, or what, for instance, constitutes a 500 kilowatt generator, and of even going farther than this and define the capacity of switches, circuit breakers, and kindred devices.

No one can suffer from such an arrangement which is entirely just to both the manufacturer and user; and with the adoption of such a rule the little remaining mystery concerning the practical side of electrical apparatus would disappear as it should do.

The electrical manufacturer while justly entitled to much credit for the advancement of the science, and the making of electrical railroading practical, has many sins to answer for under this heading of mystery, and the only power on earth which can absolve him from his remaining sins of this description is the united action of the users of his product to define distinctly and clearly what his product shall be called. And it makes no difference to him whether some particular article of his production is called a horse or an elephant, providing his competitors' production, which should do the same work, is similarly designated. But, if he uses the term horse, and his competitor that of elephant, he is of course at a great disadvantage. While the purchaser who may not be thoroughly conversant with the different terms as applied may supposedly buy the larger animal, and when too late, discover that he has only secured a moderate sized pony.

The manufacturer who has used the larger term is not altogether to blame either, for, no class of machinery has ever yet been produced which was susceptible to so many different methods of rating as electrical apparatus, and all of which may be considered honest, all such methods being entirely dependent upon the standpoint from which its producer views the matter; as, for instance, one producer may say, I will rate a certain sized generator so that it will give a product of 300 kilowatt continuously, and never rise to a dangerous limit of heating, so he calls this a 300 kilowatt machine. Now this very machine would, for instance, develop, say, 400 kilowatt capacity for a period of two hours without rising to a dangerous degree, so some other manufacturer says that in practical operation no generator ever had a continuous load, up to its rated capacity, so a safe basis to go on is to rate the machine at what it will do for two hours, and he calls it a 400 kilowatt. The natural sequence is that some one buys a machine that is either larger or smaller than what they supposed they were purchasing, and if they are fortunate enough to escape paying more money than they should for a certain capacity machine, they are exceedingly liable to get tangled up on the proper sized engine unit to go with the machine and following in the wake of the transaction is the old story of engines being found too large or too small for the generators which they are coupled with. For this trouble, our brethren of the engine trade are not by any means guiltless; for, as some of you have learned by experience, methods of engine rating are about as flexible as those followed on generators; and I trust that I will not be accused of giving away State secrets when I say that instances have come within my observation, where the engine man and electrical agent have stood in together to make it appear to some prospective purchaser that he was getting at least all that he paid for in both engine and dynamo capacity. These evils have of course not troubled the larger roads, with their skilled engineers, so much as they have the smaller roads, and the newer ones which were about to begin business; yet, it is unquestionably wise and just that all opportunities for mistakes, misunderstandings and misrepresentation on such features should be forever done away with.

What has been said on generator rating applies with equal or even greater force to the rating of street car motors; for even greater differences exist in defining their capacity than is met with in generator practice. In fact, the varying features necessitated by the construction of motors for various characters of service, furnish greater opportunity for mystery than in connection with stationary machines, and the best of engineers are occasionally imposed upon by misused terms in connection with some particular class of motor, consequently some definite rule is even more necessary for their rating.

For both generators and motors it is imperative that there be some prescribed rule as regards the character and method of their insulation. In natural sequence to the question of motors comes that of car wiring. It is customary with all the manufacturers of car equipment to furnish a liberal quantity of good material for this purpose, and as to a great extent the work of installing the same is done by the railway companies themselves, troubles from this source are not nearly so numerous as formerly, yet there are cases where installation is done by manufacturing companies, car builders and outside contractors, which would never pass inspection were the wiring done in any building of our larger cities. While the necessities for good work in this particular are of course far more apparent on a car body that is subjected to all sorts of movements and motions than in connection with the wiring of a building, the need of preparing for the last class of wiring was apparent years ago, and has been strictly followed ever since, so no argument is needed for the fixing of standard car wiring rules.

On standardizing switches, circuit breakers, bus bars, etc., I can offer no better argument than to state that your engineers well know the carrying capacity of certain weights of copper on their line of work and on the articles which I have mentioned the results should be as well known and established as any other feature in the transmission of current.

In conclusion, a word should be said on the important feature of protection against lightning. No detail of electric railway equipment costs so little, upon which so much is dependent as upon its lightning arresters. Defects in this particular may cause many thousands of dollars damage within an instant, so this question cannot be too carefully scanned and considered by your associations, and some standard fixed upon which will effectually protect your machinery.

On every feature of the business, the manufacturers will gladly conform to your actions and requests; and to sum up the whole situation in a nut shell, they exist for your benefit, not you for theirs, and that they now look to you for suggestions instead of making them to you.

[1] Read before the N. Y. State Street Railway Association, Binghamton, September 8, 1896.—Abstract.

ELECTRICAL DEVELOPMENTS ON THE B. & O.

In about thirty days the passenger trains of the Baltimore and Ohio will be hauled through the Belt tunnel by electricity. The extension now in progress of the overhead work to allow the electric locomotives to couple with passenger trains after they back out of Camden station, will be finished in that time. Another extension at the north end of the tunnel will enable the electric locomotive to haul trains to the vicinity of St. Paul street extended. This will dispense with the use of a helping engine.

At present two steam locomotives are used to haul trains, owing to the grade, and complaint is made by residents in the northern section of the smoke. In about two months this trouble will be abated.

An improvement is being made at the power station in the installation of a large coal handling plant. The plans provide for dumping the coal from cars into a hopper outside of the building and underneath the railroad tracks. From this hopper the coal is to be passed through a crusher and carried by means of buckets traveling on an endless chain to a large storage bin. Pipes lead from this bin to the doors of the furnaces, and the coal will require no manual handling from the time it leaves the mine until it is shoveled into the fires under the boilers.

A contract has been awarded to the Maryland Manufacturing and Construction Company for the installation of a fifth power generator unit to supply reserve power in case of emergency. This plant will include an 800 horse-power Greene tandem compound engine, directly connected to a multipolar 500 kilowatt railway generator. The installation will be in charge of Chief Engineer Hull, of the Construction Company's electrical department.

The B. & O.'s complement of electric locomotives is to be increased also in another way. A contract has been awarded to the General Electric Company for a small electric locomo-

tive. This is to be used in switching freight cars on Aliceanna and Wolfe streets, and will supersede the string teams of horses now used.

A trolley wire similar to those used by the street railway companies will be employed for this service. It is proposed by the company to use electricity wherever practicable, and it is expected that freight cars now handled along Pratt street by a dummy engine will eventually be hauled by electricity.

REPORT ON RAILS FOR STREET RAILROADS.[1]

BY C. LOOMIS ALLEN.

WE are careful to purchase ties of certain kind, quality and size; spikes of a particular type and size, and to have joints of such a length, thickness and weight; the rails to be of a certain section, weight and height are specified, but as to the character and quality of the metal to be used in the rails and their appurtenances nothing generally is said. In other words, we buy our rails taking what the rail makers give us so far as quality of material is concerned. I do not condemn the railmakers or believe that there is any intention on their part to give railroad companies any material other than that which will be of good quality and finish; but when the wear of traffic shows that there are certain defects in the rail, we naturally seek the cause and if possible the remedy. Some of our nine-inch rails after a traffic of two years, have shown such signs of wear considering the length of time they have been laid, that after investigation we have concluded that rails of a harder quality of steel would not have shown the wear of traffic to such an extent.

Rails of hard steel, the analysis of which showed a greater percentage of carbon than the standard specification of rail steel have been advocated by some of the steam railroad systems for some years, and I might add that their use has been a success in every way. The most notable instance of high carbon rails is that of the New York Central Railroad, upon the Hudson River division, near Spuyten Duyvil. These rails have been subject to as heavy traffic as any rails laid on this Continent. They have been under traffic for nearly six years, and up to this time, I believe, none have broken. When these rails were first delivered by the makers, so certain were they that the rails would become broken under traffic, that due warning was given the railroad company by the makers that they would not be responsible for the damage which would most certainly occur from breakage. It was my good fortune early this year to consult with one of the firms of inspectors of steel in regard to the wearing quality of high carbon rails as compared with that of rails known as standard Bessemer rail steel, and their judgment was that high carbon rails will give from 40 to 60 per cent. greater life than rails of standard Bessemer steel.

When steam roads began to ask for steel rails, the composition of which called for high carbon, an extra price from $2 to $4 per ton was asked by the railmakers, but to-day these rails are obtainable for the same price as those of standard rail steel specifications. In Syracuse this year we are laying rails 60 feet in length, 9 inches in height, and the half groove section. Our joint is the ribbed or corrugated twelve bolt, thirty-six inch joint. Our contract with the railmakers calls for rails the composition of which is as follows:

Carbon from 53 to 63; phosphorus, not to exceed .095; sulphur, not to exceed .07; Manganese, 80 to 1.00; silicon, .10 to .12.

We have had five miles of track of this specification, and in hopes to lay this year twenty miles, and we are expecting great results from these rails. I have noticed that the wear on the head of the rail by car wheels in the course of a month does not make any impression other than brightening the head of the rail; while in rails of standard specification I have seen the traffic of two weeks roll the metal in the head of the rail to the outside of the head to a very perceptible degree. The fact that there is a longer life to rails of hard steel will appeal to every railroad man as an economy which cannot be sacrificed.

THE POPE ELECTRIC VEHICLE.

There has been much interest in the expected appearance of the electric carriage made at the Pope bicycle factory, in Hartford, Conn. One evening the past week it appeared upon the streets of that city and was examined with great interest. The Hartford "Post" in speaking of it the next morning said: "The carriage is of a graceful, low body phæton form, handsomely upholstered. The front whels are about 24 inches in diameter, and the driving wheels about 32 inches. The carriage is of a handsome design and presents a luxurious appearance. The wheels have large inflated rubber tires, their size making riding in the carriage exceptionally agreeable. The storage system of electricity is used and the battery is placed beneath the seat. The power is applied to the axle of the hind wheels, speed being developed by a system of cogs. The power is controlled by a lever and there is a tiller to direct the course of the vehicle by turning the front wheels from side to side. A very pretty effect is produced by the carriage at night, there being quite a large reflector in front of the dashboard and lamps on each side. The new Pope carriage has seats for two persons, and it gets over the ground very smoothly and does its work finely."

MEETING OF THE NEW YORK STATE STREET RAILWAY ASSOCIATION.

THE fourteenth annual meeting of the Street Railway Association of the State of New York was held at the Bennett House, Binghamton, N. Y., Tuesday, September 8, 1896.

President G. Tracy Rogers called the meeting to order at 10:30, and Secretary Frick called the roll, when it was found that the following gentlemen were in attendance: C. Loomis Allen, Syracuse; J. P. N. Clark, Binghamton; W. W. Cole, Elmira; H. S. Cooper, Schenectady; R. E. Danforth, Buffalo; P. C. Deming, Buffalo; H. C. Evans, Brooklyn; Benj. Frick, Whitestone; Frank Gould, Oneonta; William E. Haven, Fishkill; J. M. Johnson, Binghamton; F. M. Hallock, Elmira; H. H. Hallock, Elmira; J. B. Lamfield, Binghamton; F. J. Maloney, Elmira; John H. Moffitt, Syracuse; F. P. Mooney, Cortlandt; Ira McCormack, Brooklyn; R. T. McKeever, Gloversville; Edmund O'Connor, Binghamton; George T. Rehn, Hornellsville; H. A. Robinson, New York; G. Tracy Rogers, Binghamton; John B. Rogers, Binghamton; C. L. Rossiter, Brooklyn; F. O. Rusling, Rochester; E. F. Seixas, Amsterdam; George H. Sliney, Brooklyn; J. H. Stedman, Rochester; C. B. Story, Hoosic Falls; Amos Van Etten, Kingston; Timothy S. Williams, Brooklyn; James I. Younglove, Johnstown.

President Rogers then read his opening address:[1]

The report of the Executive Committee was then presented, from which the following is taken: "Never before in the history of the association has there been such a large number of measures introduced in both branches of the Legislature in a single year, pertaining to the organization, operation and maintenance of street railroads. There were introduced during the last session of the Legislature, eighty-seven Assembly and fifty-three Senate bills, making a total of one hundred and forty bills and amendments directly affecting street railroad interests. The majority of bills introduced the past year were important in character, and would, had they become laws, have seriously affected the physical and financial operation of street railroads throughout the State.. We most heartily approve of the zeal, fidelity and persistency displayed by the officers, counsel and members of this association in advancing and protecting mutual business interests throughout the year."

The report of the treasurer showed the following financial transactions during the year: Receipts, $6,997.86; expenses, $6,700.88; balance, $296.98.

The reading of reports was then taken up, the first being by Mr. J. H. Stedman, of Rochester, "The Matter of Transfers." In part the report read as follows.

"One of the most important things to do and to do promptly, is to educate the average man and woman to ride. That this is largely a matter of education every street railroad manager knows. A liberal transfer system, properly guarded to prevent fraud, pays. This is, I think, now generally recognized. Local conditions and arrangements of lines must be considered in determining the regulations to be adopted. The rules intended to safeguard the company are important. Perhaps equally important is the making of rules broad enough to encourage riding.

"A large road in Baltimore three years ago employed me to arrange a transfer system. They yielded to my advice for more. extent of four transfer points, but I argued in vain for more. One year after, the manager again sent for me and said, 'When you urged me a year ago to increase my transfer privileges I thought you were a fool, and I am now convinced by a year's experience that the fool was another party.' The expediency of a liberal transfer system is beyond argument; it is an established fact; it does increase cash receipts. The more liberal, the more advantageous.

"Whether it is better to ring up transfers is a subject which has provoked much discussion. To ring them up does, of course, give them at once a cash value; but not to ring them paralyzes the spotter or detective, and the latter, I think, is generally admitted to be of greater importance. The weight of opinion seems now to be to ring up transfers, and preferably on a separate register. Nothing is absolutely a safeguard

[1] See page 283.

except the transfer method itself. With a protective transfer guarded by the coincidence of time and consecutive number in sequence of issue, honesty may be secured."

President Rogers stated that they had adopted transfers on their road, with a great deal of benefit to themselves and also to the public.

Mr. Rossiter inquired as to whether bicycles are seriously hurting the revenues of roads; and also how one can ascertain whether the transfers increase cash receipts. They were all in the habit of making comparisons with the corresponding month a year ago. Of course, the conditions are not the same in any of the larger cities. They gave a good many transfers and had made a very good showing. They might have made doubly as good a showing if they had not given any transfers. They carried 2,600,000 passengers on free transfers last month, and increased their earnings about $40,000. The other roads in the city which publish their reports monthly report a decrease, but there were a number of reasons why they should increase. They give a transfer to a passenger who is riding on a transfer.

Mr. Deming stated that in Buffalo there were a number of lines where it was necessary to give a second transfer, and in some cases a third. He found more trouble with passengers on a pleasant Sunday afternoon when they are riding around for pleasure than any other time. The system is laid out in such shape that it is possible to ride all day long on a transfer (Laughter.) He had been studying a new form of transfer, which may put a stop to it. That is, the idea of having every street that they run by printed on each transfer. When a passenger gets on one line, and wishes to go to a certain part of the town, he must ask for a transfer to that street, and that transfer is good on any car connecting the two lines. The transfer will be taken up by the conductor, and another issued to the passenger punched for the same street, and the moment the street is reached the ride ceases.

Mr. Stedman inquired whether people would not be inclined to "play the limit," and go as far as they wanted to.

Mr. Deming thought not any more so than they did now.

President Rogers inquired whether any roads transferred from one company to another company?

Mr. Cole stated that that was done in Elmira, but only on special occasions, when there was some combined attraction at the park.

Mr. Robinson: A great deal of difficulty arises in New York from the use of transfer tickets. There are some lines on which persons can get five or six transfers, and continue riding all day, if desired. We also have difficulty at the points where we have transfer agents and the tickets are punched. The passengers give the tickets to boys and the boys sell them, or they put them in places where other people can get them. Some investigations have been made to see whether people use tickets illegitimately, and although no record is kept of it, it is found from general observation that the abuse is not great. There are not many transfers to one person of more than three in number; such cases are few and far between. We consider that on some lines transfers have been of great benefit in increasing cash earnings, particularly in the retail dry goods district.

President: I think the general adoption of the transfer system is an indication that the street railroads are anxious to serve their patrons. There is no law compelling us to give the transfers, but the roads have done it, and they have found that in accommodating the public they have increased their revenues.

Mr. Moffitt stated that in Syracuse they carry about 25 per cent. of their passengers on transfers. Other members gave the following figures: Buffalo, about 32 per cent.; Binghamton, about 25 per cent.; Rochester, old system, 35 to 40 per cent.; new system, 27 to 30 per cent.; Brooklyn (Nassau Road), 20 to 25 in summer, 16 to 20 per cent. in winter; Brooklyn (Atlantic avenue Road), average 16 per cent.

The paper of C. Loomis Allen, of Syracuse, on "General Track Construction and the Most Approved Method," was then read.[1]

Mr. Rossiter stated that his road called for practically the same thing as in the paper, except the 30-foot lengths, but of high carbon. They were very satisfactory. They had had a few rails break in handling, but the results under wear were very much more satisfactory.

Mr. Evans stated that the Nassau Electric road (Brooklyn) used the regular Bessemer rail specification. The West End road, in Boston, used a little harder rail than any other road in the country. It was very seldom that the rail makers are asked for rails made up on any other than the regular Bessemer rail specification.

The next topic was the paper by Mr. W. W. Cole, of Elmira, "How can we prevent Accidents and Increase the General Efficiency of Employés."

[1] See page 281.

President Rogers called upon Mr. Robinson to explain the system of instruction in vogue on the Metropolitan street railway lines.

Mr. Robinson stated the Metropolitan Street Railway Company of New York organized a club, the chief object of which was to educate the motormen and conductors, and held meetings, to which all other operatives of the company were invited. The president opened up a room in one of the depots, and during the last season, ending the first of May, there were a series of lectures held every two or three weeks, illustrated with appropriate stereopticon views, and the subject of underground trolley, cable machinery, cable apparatus, in fact, the general operations of the road were made plain by means of the photographic views. He thought individual instruction preferable to that received at the lectures, but the lectures were entertaining, and they had been largely attended by the working classes. On the whole, they are considered very advantageous, and it is proposed to continue and, in fact, enlarge them during the coming winter.

President Rogers: Mr. Rossiter, do you not have a meeting once a week?

Mr. Rossiter stated they depended entirely on the instructors at the present time to turn the men over to the superintendents, competent to run the motors, and the superintendent is supposed to instruct them in regard to the details of each division, grade crossings, stops to be made at certain streets, etc.

Mr. Fitch, of the Erie, and Mr. Hammond, of the Delaware & Hudson Canal Company, gave the result of their experience in the same line.

A paper by Mr. H. S. Newton was then read, entitled. "Power from the Trolley Circuit, etc."

Mr. Cole stated that some of the small roads run so close to the entire output of their generators that if they supply the power consumers they can never figure on the power they are going to have on the line. Mr. Story thought it best to run power circuits from a separate dynamo.

The paper by Mr. James B. Cahoon, on the "Daily Inspection and Care of Car Equipments" was then read.

President Rogers called for remarks on this paper.

Mr. Cole thought that there were some objections to the motormen or conductors making any special inspection; it soiled the clothing in a short time, and the men would wear a poorer class of clothing. It was unpleasant for the passenger to have a conductor with dirty hands.

A paper was then read by Mr. H. S. Cooper, of Schenectady, on "The Desirability of Forming a Board of Claim Agents."

AFTERNOON SESSION.

The first business was the reading of a paper by Mr. F. O. Rusling, of Rochester, on "The Use of Old Rails as Underground Conductors."

There being no discussion on this paper, the meeting proceeded to consider the next paper, entitled "Railway Power Stations," by Mr. Thomas Henning, of Buffalo, N. Y.

Mr. W. J. Clark, of New York, upon invitation of the President, contributed a paper on the general subject of "Rating of Electric Railway Apparatus."[2]

Mr. H. A. Robinson then submitted some notes on the management of accident cases as practiced by the Metropolitan Street Railway Company.

The president stated that an invitation had been received from Mr. W. Caryl Ely, President of the Buffalo and Niagara Falls Railroad, to hold the next convention at Niagara Falls; also that an invitation had been received from Saratoga.

On motion of Mr. Clark, it was decided to hold the next meeting at Niagara Falls, and that two days be devoted to the meeting.

The following officers were then elected for the ensuing year: President, G. Tracy Rogers, Binghamton, N. Y.; 1st vice-president, W. Caryl Ely, Niagara Falls, N. Y.; 2d vice-president, John N. Beckley, Rochester, N. Y.; executive committee, H. H. Vreeland, New York; John W. McNamara, Albany; Henry M. Watson, Buffalo; C. L. Rossiter, Brooklyn; secretary and treasurer, H. A. Robinson, New York.

The meeting then adjourned to meet at Niagara Falls the first Tuesday in September, 1897, and the delegates started for a trolley ride to Ross Park, State Hospital, and other local points of interest, terminating with a ten-mile ride to Union.

A banquet was held in the evening.

PITTSBURG, PA.—Director J. C. Brown, of the Department of Public Safety, has let the following contracts: Gas and electric light plant for the new public safety building on Sixth avenue, to J. L. McShane & Co., $3,000; disinfectant plant, to the Kensington Engine Company, Limited, of Philadelphia, for $3,099; storage battery system was captured by the Gamewell Fire Alarm Company, for $4,270.

[2] See page 280.

THE CONDITIONS OF THE STREET RAILWAY INDUSTRY.[1]

BY G. T. ROGERS.

The past year has not been marked by any startling or radical changes in the street railway world. The same tendency toward better building seems to prevail. The extension of roads into the country, the construction and adoption of high speed motors and larger cars and the rolling and laying of sixty-foot rails have all been tried successfully. The exercise of greater care in providing for the return current is to be observed, but perhaps the most important advance is in the universal adoption by large plants of the direct connected generators; indeed I am informed that over eighty per cent. of the generators produced during the past year are of this character.

However, it still remains a question whether the adoption of direct connected units is true economy in smaller cities and towns where the total demand for power is not great, real estate comparatively cheap and the load variable, necessitating the use of several small units. The relative cost is greater than where the sizes are larger. The advantage of connecting several small units to shafting to avoid an entire shut-down is also to be considered. In short, each type of generator is adapted to certain conditions to be met.

The experience of the past year has demonstrated that where very long lines of street railways are to be operated, power can be economically delivered twenty miles or more from the power station by the three-phase system and the use of high tension current. The experience of the past year has also demonstrated that with direct current machines longer lines than we had previously supposed, can, by the addition of boosters, be operated economically. Some fifteen or twenty different roads in the United States are now using this system. All of these improvements are enlarging our field of business and opening the sole available field of connecting suburban towns.

The new subway in Boston is rapidly approaching completion. It is unique in many respects. The cars on the overhead trolley system will leave the surface and by a rapidly descending grade enter a double track subway with underground stations at intervals. The subway will relieve the streets in the congested sections of the city very considerably. A unique feature of the system will be the terminal arrangements at points where the different routes end. Instead of returning upon the same tracks, the car will continue forward past an "island" station and by the former level and the opposite track. High speed can be maintained in sections of the city where it would otherwise be impossible.

A number of interurban and suburban trolley roads have been completed and operated during the past year with almost phenomenal success. A well built road of this character, starting from a fair sized city, and owned and operated by the city company and tributary to its system, connecting one or more thrifty villages with the city, to my mind, will pay. Such has been our experience with the Binghamton, Lestershire and Union Railroad. In this case we own most the right of way, obtained where necessary by proceedings under the laws as amended in 1895. We generally found the farmer along the route welcomed the trolley road since it served him personally, which a steam road would not, and he was very reasonable in his demands.

Never in the history of this association have there been so many questions of vital importance confronting us. I will call your attention to a few and I trust that in case some of you do not agree with me in my views, you will pardon my alluding to the present political situation. In my opinion it is bad policy for the railroads to enter the political field, but we should, as far as possible, see that good, clean men are elected to make the laws under which we act. The street railways of this country can take but one position on the money question which is now forced upon us. Our bonds, both principal and interest, are almost uniformly payable in gold, and should this country adopt the silver basis, we must pay gold and accept the depreciated currency of the country for our fares which are fixed and cannot be advanced. We cannot place the situation before our employés any too forcibly or plainly, as they will be the greatest sufferers. The situation is a grave one for all railroad interests and demands our careful consideration.

From the Railroad Commissioner's report of 1895, I find that it has cost all roads of the State 91½ per cent. of their gross receipts for operating expenses, interest, taxes and rentals. Ninety-one and one-half per cent. of the five-cent fare we receive is four cents, five and three-quarter mills, leaving but four and one-quarter mills profit for dividends. In New York City one legitimately rides twelve and one-half miles for five cents, transportation .004 per mile; in Brooklyn eighteen miles, transportation .0028 per mile, and in Buffalo thirteen and three-quarter miles, transportation .0037 per mile. The street railway in the State of New York to-day affords the cheapest transportation in the world.

The question of fenders is still confronting us and is a most perplexing problem. More patents for street car fenders have been granted during the past few years than for any other class of inventions. It is stated upon good autherity that there are upwards of four thousand on the market, and I dare not estimate the number left in the brain of would-be inventors. It is the opinion of many street railway men that the fender is a menace.

Your Executive Committee were anxious that an act be passed regarding fenerds. There were a number introduced. The one introduced by the chairman of the Assembly Railroad Committee seemed to meet the approval of the public and was heartily endorsed by your Executive Committee, but for some reason it never became a law. The street railways are anxious that the State should share some of the responsibility. I stated last year, and still believe, that the best fender for the front end of a car is a clear headed motorman.

The pleasant relations now existing between the steam railroad and street railway companies of this State are a subject of congratulation, although in many instances the interests are conflicting. In many States it is almost a case of the Kilkenny cats. It is a pleasure to be able to state that the existing situation in New York has been largely brought about by the Executive Committee of your association. A proposition to consolidate the two organizations in one association is now under consideration.

[1] Abstract of Presidential Address before N. Y. State Railway Association, September 9, 1896.

MOTORCYCLE RACES AT PROVIDENCE, R. I.

An interesting series of motorcycle races came off last week at Providence, in Narragansett Park, under the auspices of the Rhode Island State Fair Association. Prizes of several thousand dollars in the aggregate were offered, and the main idea was that if weather permitted, five races, each of five miles, should take place, or one daily. The following were the entries: Duryea Motor Wagon Company, Springfield, Mass.; Morris & Salom, Philadelphia, Pa.; W. Lee Couch, New Brighton, Pa.; Lewis Brown, Sawkill, N. Y.; P. F. Olds & Son, Lansing, Mich.; Riker Electric Motor Company, Brooklyn, N. Y.; J. Frank Duryea, Springfield, Mass.; Geo. H. Morrill, Jr., Norwood, Mass.; Geo. H. Hewitt, Springfield, Mass.; Fiske, Waren & Co., Boston, Mass.; Wm. M. Ashley & Son, Springfield, Mass.; C. Mayhew & Son, Saratoga Springs, N. Y.; The Morris & Salom and Riker electric carriages, already described in these pages, were the only electric vehicles entered. Nearly all, if not all of the others, were of the gasoline motor type.

Owing to the severe storm which swept the New England coast during the week, with effects felt for two days, the plans for the race were thrown into disorganization and had to be modified in keeping with the horse, bicycle and other races, all of which were affected by the prevalence of the storm and the condition of the track. The motorcycle contestants were desirous of going on in spite of the weather, but as the management had an eye to the attendance and gate money, it declined. The result was that but three of the heats were run, two being won by the Riker carriage, while the Morris & Salom vehicle also made a better showing than the Duryea. The prize money offered had been corespondingly reduced, and but three-fifths of it will be paid.

The Riker motor won the first two heats;the Morris & Salom the third, with he Riker a few yards only behind. The fastest mile was made by the Riker motor in 2 minutes 13 seconds. The fastest five miles was that of the Morris & Salom in 11 minutes 27 seconds. The first prize to the Riker is $900; the second to the Morris & Salom is $450. The prizes would have been larger had all the heats been run.

LEGAL NOTES.

TROLLEY BASE LITIGATION.—THE SIMONDS MFG. CO.

The United States Circuit Court for the District of Western Pennsylvania has modified the injunction obtained against the Simonds Manufacturing Company by the Thomson-Houston Electric Company, permitting the former now to sell trolley parts of all kinds, and the trolley base under the Duncan patent.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Current:

WATTLESS CURRENTS IN POWER DISTRIBUTION BY MEANS OF ALTERNATING CURRENTS.—By André Blondel. Paper read before the International Congress of Electricians at Geneva. The magnetizing wattless current, which lags 90 degrees, forms the subject of the paper. In the discussion the terminology of the word was subjected to lively debate, Palaz, Hospitalier, Ferraris, Mascart and others taking part.—Lond. "Engineering," "Elec Rev.," Sept. 9, '96.

Dynamos and Motors:

CONTINUOUS CURRENT GENERATOR FOR THREE-WIRE SYSTEM.—By A. Rothert. The three-wire system for electric lighting would be more popular still than it is, if it did not require two small dynamos instead of one large machine. The neutral wire could be joined to a third brush placed midway between the two others; such brushes are right in the field, however, and spark badly. Generators with two independent windings on the armature and two collectors in series had answered under certain circumstances. Dobrowolsky has connected two fixed points on the armature of maximum potential difference by a choking coil, and has started the neutral wire from the middle of this coil.—Lond. "Engineering," "Elec. Rev.," Sept. 9, '96.

Measurements:

METRIC SYSTEM.—Test of Government bill brought by the president of the Board of Trade to legalize the use of weights and measures of the metric system.—Lond. "Practical Eng'r," Aug. 14, '96.

Mechanical:

DOUBLE CROSSLEY GAS ENGINE AND DIRECT DRIVEN DYNAMO.—Illustration of a 60 nominal horse-power gas engine running at 160 revolutions per minute and direct coupled to a Siemens & Halske dynamo.—"Sc. Am. Supplem.," Sept. 5, '96.

RUNNING EXPENSES OF GAS VS. ELECTRIC MOTORS.—Detailed experimenting disclosed that the expenses for the gas motor running free were 56 per cent. of the motor running at full load, while the electric motor running free showed an expense of 13 per cent. of the same, running full load. When running under full load, however, the gas motor is 26 per cent. cheaper than the electro motor.—From "Uhland's Verkehrszeitung" and "Génie Civil," in "Elektrotechn. Anzeiger," Aug. 30, '96.

Power Transmission:

HIGH TENSION CONTINUOUS CURRENT DISTRIBUTION.—By René Thury. Paper read before the International Congress of Electricians at Geneva. The system has been adopted in Biberist, Brescia, Geneva, Genoa, etc. The Biberist line has a length of 15 miles; in Brescia 700 horse-power are transmitted over a distance of 12 miles; up to 15,000 volts are employed. Thury claims that his lines are easily calculated and his switchboards simple; that the regulation of the speed of the motors answers well; the motors can easily be started; that the consumers can not use more current than they are entitled to; that the lightning trouble, which is very serious in many parts of Switzerland, has successfully been overcome, and that the high tension involves no danger. His machines stand on porcelain insulators, imbedded in cement or beton; the floors are asphalted.—Lond. "Engineering," "Elec. Rev.," Sept. 9, '96

LONG DISTANCE POWER TRANSMISSION.—By Charles S. Bradley. Paper presented to the International Congress of Electricians at Geneva. The paper consisted of two sections: (1) Author advocates monophase transmission down to his transformers and polyphase motors. (2) He discussed his ideas on phasing transformers. In abstract only in Lond. "Engineering," "Elec. Rev.," Sept. 9, '96.

Roentgen Rays:

A LECTURE ON THE RECENT ROENTGEN DISCOVERY.—By Fred S. Kolle, M. D., Brooklyn.

This lecture is one of twelve delivered in Brooklyn, and consists of a résumé of the work done up to date. Dr. Kolle was one of the first medical men to take up the subject, and he has devoted his thoughts and energies to it systematically. He advances some useful ideas and suggestions. (Pamphlet.)

WAVE LENGTH OF ROENTGEN RAYS.—Dr. Fromm found the wave length about fifteen times smaller than the smallest hitherto observed in ultra violet. Further details are taken from "Nature" in "Elec. Eng'r," Sept. 2, '96.

Thermo-Electricity:

COX THERMO-ELECTRIC GENERATOR.—The various improvements which have been made principally in consequence of welding the various elements together. Also a description of Mr. Cox's laboratory in England.—Lond. "Elec. Rev.," "Elec. Rev.," Sept. 9, '96, "Elec. Eng'r," Sept. 9, '96.

Telephony, Telegraphy, etc:

CABLE LAYING GEAR ON THE STEAMSHIP "TUTAUEKAI."—An illustrated description in "Elec. Rev.," Sept. 9, '96.

Wiring:

AUTOMATIC DISCONNECTION OF BROKEN WIRE FROM CIRCUIT.—Gould & Company patent specification. An illustration and description of a peculiar coupling, by means of which an entire section of wire is thrown to the ground in the case of breaking at any point, thus preventing a hanging wire.—"Elektrot. Anzeiger," Aug. 30, '96.

NEWS AND NOTES.

A NEW YORK GAS EXHIBITION.

THE plans for a gas exhibition in this city appear to be now in good shape, and the preliminary announcements are made in the "Progressive Age," of this city, whose well known editor, Mr. E. C. Brown, appears to have affairs in charge. The place is to be Madison Square Garden, and the time will, in all probability, be two weeks in January, 1897. This does not leave too much leisure for preparation, but as the Garden is always ready and as the exhibits do not take long to fit up, it should prove ample. About 20,000 square feet of space will be provided for exhibits, and of this, over 5,000 square feet had been taken up before public announcement. In size, therefore, the Gas Exhibition will by no means approach the recent Electrical Show, nor can it possibly compare with it in the variety of industries illustrated or affected, but it should prove very interesting and attractive. Gas is still a mighty agent for illuminating purposes, and there should be many exhibits of that nature, while the season of the year will offset the heat likely to be generated by a large consumption of gas. But there are other things of importance and worthy of inclusion, and we trust that the whole gas art will be demonstrated in an instructive manner. It is greatly to be hoped that there will be a good and comprehensive exhibit of gas engines. We think such things should also be included as thermo-generators, giving the public an opportunity to see a gas jet furnishing electrical energy enough to run a fan motor, a light, and half a dozen other pieces of apparatus. In fact, many central station men are to-day actively interested in the use of fuel and illuminating gases, and the exhibition may be considered as no less useful to all electric lighting engineers and managers, and should be no less an incentive to them than to those who are specifically devoted to the manufacture and distribution of gas.

REPORTS OF COMPANIES.

WESTERN UNION.

The Western Union Telegraph Company have declared a quarterly dividend of 1¼ per cent. The following is a statement of business as compared with actual figures in 1895: Net revenues of $1,600,000, a decrease of $242,648; interest and sinking funds, $243,500, a decrease of $57; balance $1,356,500, a decrease of $242, 591; dividends, $1.191,960, an increase of $15; surplus, $164,540; a decrease of $242,606; previous surplus, $7,643,693, an increase of $196,217; total surplus, $7,808,-233, a decrease of $46,389.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 8, 1896.

Alarms and Signals:—

CONTACT DEVICE FOR ELECTRIC BURGLAR ALARMS. P. Unger, Lemont, Ill., 567,176. Filed June 22, 1896.
Details of construction.

ELECTRICAL TRAIN SIGNALING DEVICE. J. E. Young and E. S. Norton, Conneaut, O., 567,211. Filed May 11, 1896.
Means for sounding an alarm in the engine cab when an accident has happened to the train.

Distribution:—

ELECTRICAL TRANSFORMER. H. M. Hobart, Boston, Mass., 567,237. Filed May 15, 1896.
A built up core having its sides and ends composed of bundles of laminæ of magnetizable material united at their ends.

ELECTRICAL TRANSFORMER. W. S. Moody, Lynn, Mass., 567,250. Filed March 30, 1896.
Details of core construction.

TRANSFORMER FOR ELECTRIC CURRENTS. R. Thury, Geneva, Switzerland, 567,424. Filed Feb. 3, 1896.
Details of construction.

Dynamos and Motors:—

CONSTANT POTENTIAL ALTERNATING GENERATOR. E. W. Rice, Jr., Schenectady, N. Y., 567,197. Filed May 15, 1896.
In combination, an alternating current dynamo electric machine, a transformer having a primary coil in shunt to the mains, a secondary, and a modifying magnetic shunt, and a rotary converter connected upon its alternating current side to the transformer secondary, and upon its other side to the field magnets of the alternator.

DYNAMO ELECTRIC MACHINE. R. Thury, Geneva, Switzerland, 567,423. Filed Aug. 5, 1895.
The combination with the magnetic poles, of a series of laminated rings and a continuous surface of wire in groups wound in opposite directions, so that the alternating magnetic actions set up currents throughout the coils.

Electro-Metallurgy:—

MAGNETIC SEPARATOR. R. Eickemeyer, deceased; R. Eickemeyer, Jr., executor, Yonkers, N. Y., 567,381. Filed Jan. 10, 1890.
A rotative drum provided with longitudinal separating bars of iron, and an interior stationary electromagnet, having a series of ribs, segmental in form and each inclosed longitudinally by its own field coil.

MAGNETIC SEPARATOR. R. Eickemeyer, deceased; R. Eickemeyer, Jr., executor, Yonkers, N. Y., 567,382. Filed Jan. 28, 1890.
Similar to above.

PROCESS OF EXTRACTING GOLD AND SILVER FROM THEIR ORES. L. Pelatan, Paris, France, and F. Clerici, Milan, Italy, 567,503. Filed Jan. 10, 1896.
Consists in submitting the ores of gold and silver to the action of a comparatively weak cyanid solution containing chlorid of sodium and treating them electrolytically.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. F. G. H. Faure and J. MacHaffie, New York, 567,227. Filed March 20, 1896.
Details of a focusing arc lamp.

SAFETY DEVICE FOR HANGING ELECTRIC ARC LAMPS. E. P. Snowden, St. Joseph, Mo., 567,322. Filed Jan. 23, 1896.
Means by which the current is shifted from the lamp direct through the springs when the lamp is lowered.

ELECTRIC SIGNAL LAMP. J. R. Farmer, St. Louis, Mo., 567,338. Filed March 14, 1895.
A lamp that revolves automatically on the approach of a car.

ARC LAMP CLUTCH. H. R. Palmer, Norfolk, Va., 567,355. Filed June 10, 1896.

HOLDER FOR ELECTRIC LAMPS. W. S. Arnold, San Francisco, Cal., 567,531. Filed March 17, 1896.
Details of construction.

Miscellaneous:—

ELECTRIC LOCK. W. S. Nash, Knoxville, Tenn., 567,156. Filed Nov. 21, 1895.
Details of construction.

ELECTRIC HEATER. J. E. Meek, New York, 567,247. Filed Jan. 7, 1896.
Consists of a woven fabric of asbestos, with an electric conductor embedded in the woof of said fabric, and a backing of incombustible mill board.

ELECTRIC HEATER. J. E. Meek, New York, 567,248. Filed Jan. 7, 1896.
Similar to above.

GALVANIC RING. M. L. Thompson, Brooklyn, N. Y., 567,422. Filed June 29, 1896.
Invented for medical purposes.

ADVERTISING DEVICE. F. A. Ruge, Springfield, N. Y., 567,514. Filed May 22, 1896.
Means for closing the circuits through any desired series of lamps and leaving the others cut out.

SWING FOR ELECTRIC LIGHT OR TELEPHONE BRACKETS. A. Petereit, New York, 567,550. Filed Nov. 15, 1895.
A joint consisting of a slotted hollow main section or socket; in combination with a removable section adapted to be supported in the first section.

ELECTRIC TYPESETTING MACHINE. Joseph Sachs, New York, N. Y., 567,256. Filed Dec. 24, 1894.
Details of construction.

Railways and Appliances:—

TROLLEY WIRE CROSSING. H. M. Handsby, San Antonio, Tex., 567,133. Filed March 19, 1896.
Details of construction.

TROLLEY WIRE AND TROLLEY WHEEL. P. Cassidy, Worcester, Mass., 567,186. Filed May 8, 1896.
A trolley wire comprising a substantially cylindrical rib and a tapering V-shaped body portion for engaging the trolley wheel, and a wheel having a V-shaped groove for engaging the wire.

ELECTRIC RAIL BOND. G. H. Scott, Worcester, Mass., 567,257. Filed March 9, 1896.
Consists of a connecting rod or wire, and two collars, one for each end of said rod or wire, adapted to fit over the ends thereof, and an opening in the rails.

ELECTRIC RAILWAY TROLLEY. R. N. Dyer, East Orange, N. J., 567,306. Filed April 30, 1896.
An upward pressure trolley, a solenoid and core for moving the trolley upwardly and a multiplying gear connecting the solenoid core with the trolley.

ELECTRIC RAILWAY TROLLEY. R. N. Dyer, East Orange, N. J., 567,307. Filed April 30, 1896.
Similar to above.

TROLLEY. E. D. Preist, Schenectady, N. Y., 567,411. Filed May 13, 1896.
The combination of an overhead conductor, a contact device supported thereby, arms extending between the contact device and the vehicle, and a piece pivotally secured to the contact device and the arms, permitting movement between them.

INSULATED RAIL JOINT. R. C. Scofield, Boonton, and J. Wayland, Newark, N. J., 567,416. Filed July 22, 1896.
Comprises insulating coupling blocks at the sides of the rails and a bedplate for the rail ends having an upwardly extending rib on one side only.

TROLLEY FOR ELECTRIC CARS. J. E. Hewes, Philadelphia, Pa., 567,474. Filed May 7, 1896.
Means for lowering the free end of trolley on leaving wire.

CAR STORAGE ARRANGEMENT. E. F. Mann, Detroit, Mich., 567,487. Filed Nov. 20, 1895.
Comprises a track and trolley wire extending above the track, a break in the trolley wire near the entrance to building, and a switch located outside of building adapted to throw the trolley wire in and out of circuit.

ELECTRIC RAILROAD. O. Sill, New York, 567,517. Filed Nov. 1, 1895.
Comprises switches provided with insulation, consisting of tubes and alternate layers of cement, arranged one within the other.

ELECTRIC RAILWAY. W. F. Grassler, Williamsport, Pa., 567,540. Filed May 8, 1896.
A third-rail system.

MOTOR MOUNTING AND DRIVING MECHANISM. Ernest J. Bagnall, Cleveland, O., 567,560. Filed Sept. 4, 1895.
Permits of vertical motion only.

Regulation:

RHEOSTAT. W. W. Dean, St. Louis, Mo., 567,223. Filed March 28, 1896.
The combination, with a non-combustible core, of a resistance wire, a non-combustible, flexible envelope, metal clips, base and springs.

GOVERNOR FOR REGULATING SPEED OF MACHINERY. E. Thunderbolt, Carlton, Victoria, 567,366. Filed July 10, 1896.
The combination of an electromagnet adjustably secured to a lever having a spring attached thereto at one end and at the other end to a slotted frame in combination with a pin centered upon an adjustable plate and a vertical rod adjustably connected with the lever.

Switches, Cut-Outs, Etc:

AUTOMATIC CIRCUIT BREAKER. E. M. Hewlett, Schenectady, N. Y., 567,137. Filed April 17, 1896.
One magnetic device breaks the circuit at a predetermined overload and at the same time blows out the arc caused thereby.

Telegraphs:

TELAUTOGRAPH. G. S. Tiffany, Highland Park, Ill., 567,325. Filed June 7, 1895.
Means for charging the batteries of the various instruments of the system from a central station.

Telephones:—

TELEPHONE TRANSMITTER. R. P. Green, Columbus, O., 567,132. Filed May 31, 1895.
Embodies a secondary diaphragm and granular conducting material.

TELEPHONE SWITCH. D. Rousseau, New York, 567,170. Filed March 18, 1895.
A switch for enabling communication to be established by the subscriber with a number of telephone stations.

TELEPHONE TRANSMITTER. A. Stromberg and A. Carlson, Chicago, Ill., 567,324. Filed Oct. 29, 1895.
Employs granular carbon

APPARATUS FOR TELEPHONE SWITCHBOARDS. F. R. McBerty, Downer's Grove, Ill., 567,404. Filed Jan. 24, 1896.
Call distributing system.

SOCIETY AND CLUB NOTES.

Y. M. C. A. ILLUSTRATED LECTURE ON ROENTGEN RAYS.

On Friday evening Sept. 25 a lecture will be given in Association Hall, Fourth avenue and Twenty-third street, by Mr. Max Osterberg, E. E., A. M., on "The Possibilities and Limitations of the Röntgen Rays." Mr. Osterberg is the instructor in the evening class in electrical engineering at the Twenty-third street branch of the Y. M. C. A., and has kindly volunteered his services for this lecture.

The proceeds will be devoted to securing apparatus with which to illustrate the instruction in the class room. Besides exhibiting and explaining the Röntgen rays apparatus, Mr. Osterberg will illustrate his lecture throughout with a stereopticon lantern. Tickets may be secured at this office; price fifty cents.

THE OLD-TIME TELEGRAPHERS and the U. S. Military Telegraph Corps held their annual meeting at Pittsburgh last week, and enjoyed a very pleasant reunion. Mr. J. Compton, of Nashville, was elected president.

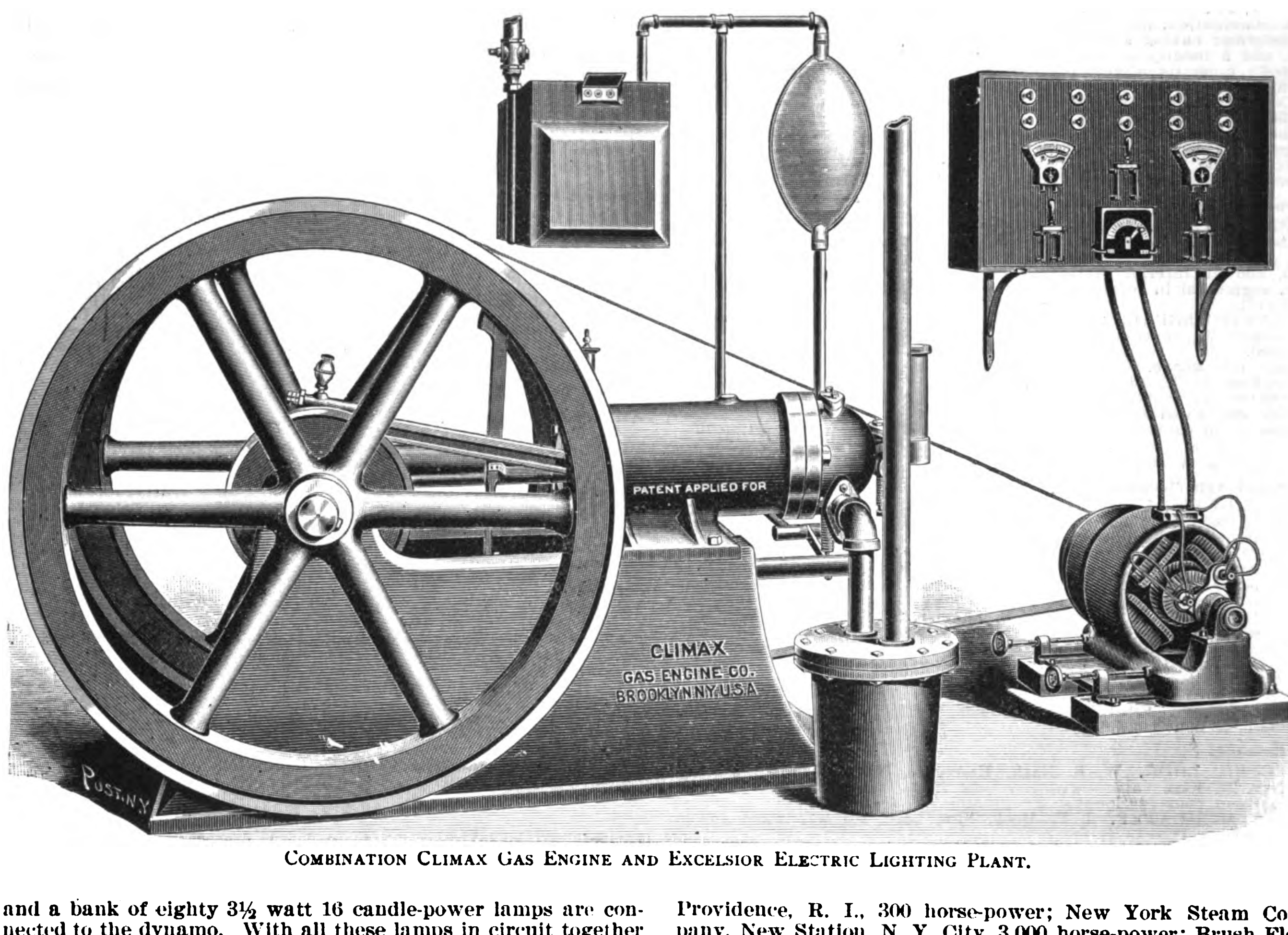
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE CLIMAX GAS ENGINE.

IT has often been pointed out that a given amount of candle power of illumination could be far more economically obtained from incandescent lamps by burning gas in a gas engine driving a dynamo than by burning gas direct in the ordinary burners. One of the most striking examples of this kind which has lately come under our notice is embodied in the gas engine on the premises of the Climax Gas Engine Company, at 31 Fulton street, Brooklyn, N. Y. This plant, which is illustrated in the accompanying engraving, consists of a Climax gas engine of 12.2 indicated horse-power, driving a dynamo of the Excelsior Electric Company of the Churchward 4-pole type by direct belt connection without countershaft. The dynamo has a capacity of 5.6 kilowatts, and operates at 110 volts at 1,250 revolutions per minute, the gas engine running at 260 revolutions.

In order to show the exact gas consumption of the engine, a meter is directly connected to the inlet valve on the engine, and a bank of eighty 3½ watt 16 candle-power lamps are connected to the dynamo. With all these lamps in circuit together with a pilot lamp, making eighty-one altogether, the gas consumption by actual measurement does not exceed 210 cubic feet per hour. It will thus be seen that assuming a five-foot burner and gas at 20 candle-power it would require no less than 325 cubic feet of gas to produce the same amount of illumination directly from gas burners.



COMBINATION CLIMAX GAS ENGINE AND EXCELSIOR ELECTRIC LIGHTING PLANT.

The engine is of the regular 4-cycle type giving an explosion at every other revolution, the crank shaft being provided with balance discs. The engine has a cylinder of 7 inches in diameter by 14 inches stroke. As the question of steadiness of running is an all-important one for engines operating incandescent lamps, the governing has been especially looked after, and the fluctuations in speed are claimed to be less than 2 per cent. The indicator cards of the engine show a very smooth curve, with a m. e. p. of 80 pounds to the square inch. The mechanical parts of the engine have been very carefully worked out and the company is now ready to deliver for immediate service three sizes of engines, namely, of 9, 13, and 35 horse-power. Larger engines for direct connection to generators for lighting, as well as for railroad service, are now in the course of preparation. The plant illustrated above can be seen daily in operation.

CLONBROCK STEAM BOILER CO.

The Clonbrock Steam Boiler Company of Brooklyn, report a large rush of business, their order sheets being so full that it is necessary to have on a night force to complete orders already booked for January 1, 1897. Among their latest orders are the American Manufacturing Company, Brooklyn, 500 horse-power; Hazelton Light Company, Hazelton, Pa., 800 horse-power; Peoples Light & Power Company, Jersey City, N. J., 800 horse-power; Municipal Electric Light Company, Brooklyn, N. Y., 2,000 horse-power and one steel self-supporting smoke stack, 16-inch diameter and 175 inches high; Economy, Light, Heat & Power Company, Scranton, Pa., 1,000 horse-power; Johnson Coal Company, Priceburg, Pa., 400 horse-power; Marshall Paper Company, Turners Falls, Mass., 150 horse-power; Peoples Light & Power Company, Orange, N. J., 200 horse-power; Geo. Watkinson Rubber Works, Philadelphia, Pa., 250 horse-power; Esperanza Plantation, Bayou Lapourche, La., 600 horse-power; Mathieson Alkali Works, Providence, R. I., 300 horse-power; Brush Electric Company, Providence, R. I., 300 horse-power; New York Steam Company, New Station, N. Y. City, 3,000 horse-power; Brush Electric Company, Baltimore, Md., 1,000 horse-power; Coney Island & Brooklyn R. R. Company, Brooklyn, N. Y., 700 horse-power.

EUGENE MUNSELL & CO'S. MICA.

Eugene Munsell & Company state that their mica business has been established more than 50 years, so that when there began to be a call for mica for electrical insulation, they had experience which enabled them to meet the demand, and that they have since been constantly enlarging their facilities, and studying to meet the varying and increasing requirements of the elctrical trade. They also state that their mica is received direct from the mines, and not through second hands.

Mr. Franklin Brooks, the junior member of the firm, has recently spent considerable time among the rich mines in Bengal, India, perfecting arrangements by which they receive the finest electrical mica in the world, selected and prepared according to their own instructions. They also have ex-

tensive relations with Canadian miners which enables them to furnish the best amber mica, where that quality is desired.

The electrical trade, as a rule, prefer to have their orders filled promptly, and this is one of the features of Eugene Munsell & Company's business of the past, that they guarantee almost immediate delivery of any orders placed with them. The company has recently established a branch house at Chicago to supply their Western customers.

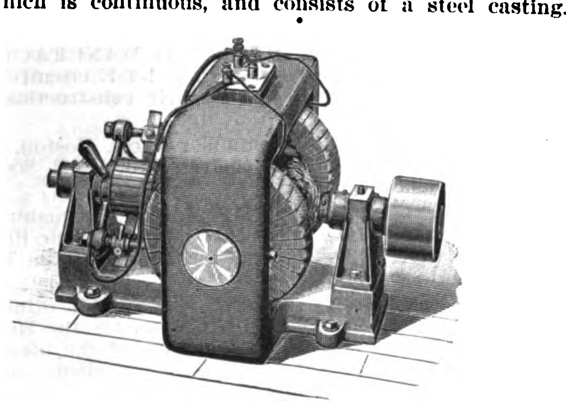
CENTRAL ELECTRIC X-RAY SHADES.

The great variety of uses to which the incandescent lamp has been put, in practical as well as purely decorative lines has taxed the ingenuity of designers to keep up with the demand for novelties. Probably in no direction has this demand been manifested more than in the line of glass, porcelain and metal shades. One of the prettiest and at the same time very useful forms recently put on the market is the X-ray shade. These are manufactured for the Central Electric Company, 173-175 Adams street, Chicago. The illustration gives but a faint idea of the brilliancy and beauty of the shade and is only one of a great number of designs carried in stock by them. They are greatly pleased with the reception given this shade by the general trade and have already sold several hundreds of them. Being plated with aluminum they can be washed with water without injury. They are suitable for all purposes where a shade is needed. It is claimed that they will greatly increase the efficiency of light. An inspection of the great stock of general electrical supplies carried by the Central Electric Company does not indicate that they are expecting any remarkable "slump" in the fall trade. On the contrary one would think they were looking for a grand revival of business, and we sincerely hope that no one will be disappointed.

THE RUPRECHT DYNAMO AND MOTOR.

OUR engraving illustrates the dynamo and motor just brought out by the Ruprecht Electric Company, of 236 Superior street, Cleveland, O.

Among the characteristics of this machine is its magnetic circuit which is continuous, and consists of a steel casting.



THE RUPRECHT DYNAMO AND MOTOR.

The field magnet-coils are wound separately and slipped over the cores which are let into the sides of the steel frame.

The commutator is divided into a large number of bars, thus reducing any tendency to spark. Forged steel shafts are employed in these motors together with phosphor bronze bearings. The center of gravity is very low and the speed as well so that these machines operate without perceptible noise or vibration. They are built in various sizes.

REPEAT ORDERS FOR McEWEN ENGINES.

It is obviously gratifying to manufacturers to receive a duplication of orders for their goods from people who, having tried them, are thoroughly familiar with their merits. The J. H. McEwen Manufacturing Company, Havemeyer Building, New York, may well be proud of the numerous repeat orders received from former patrons, the latest coming from the well known firm, Messrs. A. M. Rothschild & Company, of New York and Chicago.

Messrs. Rothschild & Company have had in operation for the past eighteen months two 100 kilowatt Thompson-Ryan generators direct connected to 15-inch by 16-inch McEwen automatic engines. They wrote very favorably about the plant at first and have just placed an order for the third machine of the same size as the first two, and thus verify their opinion formed over a year ago, when they said they could not recommend it too highly.

THE COLLIERY ENGINEER CO'S. CORRESPONDENCE SCHOOL.

The Colliery Engineer Company, of Scranton, Pa., have just issued the following circular:

"The offices of The Colliery Engineer Company, proprietors of 'The Colliery Engineer and Metal Miner,' 'Home Study,' and The International Correspondence Schools, in the Coal Exchange Building, Scranton, Pa., were partially destroyed by fire on Sunday morning, August 30, 1896.

"Fortunately, our printing plant was in another building, and we had reserves of all instruction and question papers, drawing plates, and other supplies and stationery used in the schools in still another building, so that our business will not be seriously interfered with.

" 'The Colliery Engineer and Metal Miner' and 'Home Study' will be out within a few days of the usual time, and we are already (September 2, 1896) conducting the instruction in our schools as usual. We have secured quarters on the three upper floors of the new Mears Building, corner of Washington avenue and Spruce street, Scranton, and are now prepared to enter new subscriptions to our publications and also to enroll and commence promptly the instruction of new students in our schools, as before the fire. Our new offices are even more convenient and commodious than those which we have been compelled to leave by the fire, and we expect to occupy them until the completion of our new buildings, now being erected on Wyoming avenue. Patrons of our publications and students of the schools visiting Scranton are invited to call upon us in our new quarters."

THE WURTS SWITCHES AND CIRCUIT BREAKERS.

The Westinghouse Electric and Manufacturing Company are to exhibit at the St. Louis convention, in October, a complete new line of switches and circuit breakers designed by Mr. Alex. Jay Wurts. The instruments are remarkable for ingenuity and tasteful design, and, it is claimed, will entirely revolutionize the trade in this class of instruments. The switches are especially remarkable for their novel method of making contact and for their great carrying capacity, occupying, as they do, only half the space of an ordinary switch. The circuit breakers are designed on entirely new principles, every detail of which has been most carefully worked out and perfected by the inventor. The distinctive features are the absence of contact jaws and solenoid, the delicate ease of adjustment over a wide range and the ingenious manner in which all possibility of burning at the main contacts is avoided. A beautifully illustrated pamphlet, descriptive of the instruments and new principles involved, is now being prepared and will be ready for distribution.

MR. ASTOR'S NEW ELECTRIC LAUNCH "UTOPIAN."

Mr. John Jacob Astor's handsome new electric launch Utopian went off the ways from Ayer's shipyard, Upper Nyack, on Sept. 10.

The Utopian is one of three electric launches owned by Mr. Astor. Her cost will be from $18,000 to $20,000. She is a twin-screw auxiliary launch, 72 feet over all, 12 feet beam, 3 feet 6 inches draught, and was designed by Charles D. Mosher. The motive power is electricity, and the boat will be driven by two 25 horse-power motors, built by the Riker Electric Motor Company. She will also have auxiliary sail power. Mr. A. W. Johnson, electrical engineer, will have charge of all the batteries and the machinery in general. Mr. Astor will usually run the launch himself.

The boat will have a searchlight of 10,000 candle-power, and be lighted throughout by electricity. She was built to make sixteen miles an hour. Her first trip will be to "Fern Cliff," at Rhinecliff, where her batteries will be placed at Mr. Astor's boat house, built for his electrical launches.

ENCLOSED ARCS IN DRY GOODS STORES.

Several large firms in the dry goods line have lately thrown out their open arc lamps and substituted enclosed arcs in their place on account of the trouble from falling sparks which frequently endangered their valuable stocks. The Board of Fire Underwriters strongly favors the enclosed type of arc lamp, and the Electric Arc Light Company, who are the manufacturers of the "Pioneer" 150 hour lamp, have their hands full, according to all accounts, filling large orders; and find

their new and enlarged quarters already being crowded to their utmost capacity. They need not guarantee immunity from falling sparks, as the very construction of their enclosed arc makes any such accident a practical impossibility.

NEW YORK NOTES.

"ELECTRIC POWER" has been discontinued.

THE AMERICAN MOTOR COMPANY, Hoboken, N. J., is in the market for two or three hundred induction coils giving a three-eighth inch spark.

MR. L. T. LEVY has been appointed New York agent for the Massachusetts Fan Company, of Boston, with headquarters at 109 West Fifty-seventh street.

THE C & C ELECTRIC COMPANY, 143 Liberty street, has recently been awarded the contract for the installation of a 50 kilowatt direct connected plant at the Bijou Theatre, this city.

THE SUMMERHAYS COMPANY has been formed at Rochester, N. Y., with a capital stock of $10,000, to make gas and electric fixtures and supplies. The directors are M. Hirshfield, C. B. Griffith, and C. L. Hirshfield.

THE MANHATTAN ELECTRIC LIGHT COMPANY, which takes in the old company of that name and the Madison Square Light Company, has been formed, with a capital stock of $1,500,000. The directors are R. R. Bowker, E. A. Leslie, H. M. Edwards, C. S. Shepard and F. Enos.

LONG BURNING ARCS.—The General Electric Company has in press a little booklet on its long burning arc lamps, handsomely illustrated. The subject is treated from the standpoint of the convenience and economy to the station manager and the customer, by the use of these one hundred and one hundred and fifty hour lamps. Copies of this booklet will be ready for distribution in a few days, and our readers can receive them on application to any of the sales offices of the company or directly to the Supply Department at the Schenectady office.

MR. ELIAS E. RIES, formerly of Baltimore, Md., has removed to New York City, and has opened an office as consulting engineer and electrical expert, at Room 1031, Temple Court. Mr. Ries is well and favorably known to the electrical profession as a scientific investigator and technical expert of no mean ability, and there is scarcely a line of practical electrical development in which he has not done valuable original work. Mr. Ries is an active member of the American Institute of Electrical Engineers and other learned societies, has been a frequent contributor to the electrical and engineering press, is himself an inventor of marked capability, and has an extended practical experience which well qualifies him for his new field and which fully merits the success that we have no doubt he will reap.

JOHN SIMMONS COMPANY, 106-110 Centre street, are making a specialty of several lines of iron pipe brackets and poles for street railways and illuminating purposes. Their latest production is the Excelsior railway bracket, which is made entirely of malleable iron fittings and iron pipe and is so constructed that it may be shipped entirely made up. The main feature of this bracket is a filling piece between the brace and arm, which, upon removal, allows the bend of the brace to slide through the clamp fittings. This construction permits of crowding the bracket into a very small space, obviates packing and makes handling easy. Its cost is well within limits. The John Simmons Company have been identified with the wrought and cast iron pipe and fitting trade for many years, and are probably the oldest and largest house of the kind in this country. They carry a large and varied stock of wrought and cast iron pipe, fittings, valves and supplies for steam, gas and water purposes, and especially a full stock of all goods in their line suitable for electric light stations and plants, electric railways, etc. Their extra heavy screwed and flanged fittings for high pressure modern steam plants are of the celebrated "Jarecki" make, the John Simmons Co. being the agents for this well known brand of fittings, valves, cocks and tools. This firm will cheerfully give estimates on piping for every purpose—steam, gas, water, etc., also on poles and conduits. The offices and salesrooms of the John Simmons Company are at 106 to 110 Center street; their factory, pipe cutting and machine shop occupy the entire buildings 155 to 157 Leonard street; and to facilitate the direct handling of their enormous output, storing and shipping of pipe, they occupy the bulkhead at 381 South street, New York.

WESTERN NOTES.

THE ELECTRICAL APPLIANCE COMPANY are making a large number of sales of their new telephone switchboard. It has, they claim, a number of very desirable features exclusively its own, and is in every way a practical and serviceable board.

MR. W. A. KREIDER, manager of the Chicago Office of the Ball Engine Company, Erie, Pa., 1526 Monadnock Block, has closed orders within the past week for one 100 horse-power and one 60 horse-power engine to go to Geneva, Ill.; one 100 and one 50 horse-power engine to go to Wauwatosa.

MINNEAPOLIS POWER.—The Minneapolis City Council has granted the St. Anthony Falls Company a franchise to run electric light and power wires on the streets of the city. This company is the one that is building the new dam at Minneapolis, and much of the power from the water wheels will be converted into electricity and distributed over the city to furnish light and power.

MR. J. H. PARSHALL, Detroit, representative of the Ball Engine Company, Erie, Pa., has been successful in closing several contracts for his company during the past three weeks. He has secured orders for one 100 horse-power engine for the Toledo Glass Company, Toledo, Ohio; two 50 horse-power engines, direct connected to Walker dynamos, for W. H. Millikin for new hotel building, Bowling Green, Ohio; two 70 horse-power engines, direct connected to General Electric generators, for Hammond Building, Detroit, Mich.

PHILADELPHIA NOTES.

THE ART CLUB.—Wilson Bros. & Co., Drexel building, have completed plans for a new power house for the Philadelphia Art Club, on Broad and Locust streets.

MR. JAMES G. BIDDLE has removed from 944 to 910 Drexel Building, and has also 644 as his new telephone number. He has just been appointed agent for the Ward-Leonard Electric Company, and will fill orders for Carpenter enamel rheostats.

NEW ENGLAND NOTES.

MR. F. S. BURKE, manager of the Crown Woven Wire Brush Company, of Salem, Mass., starts on a Western trip this week. He informs us that trade is picking up with them, and that there is every indication of a good fall and winter business in their line. The company have enlarged their producing capacity, and are manufacturing everything in woven wire brushes.

ADVERTISERS' HINTS.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY continue to advertise their I-T-E circuit breakers and claim that the principles of their construction render them superior to anything in that line.

CHARLES N. WOOD, 180 Summer street, Boston, is offering a few three or four turn armatures for G. E. 800 motors at reasonable terms.

McEWEN ENGINES AND DYNAMOS are manufactured for belt driven and direct connected service. Their illustrated catalogue is well worth sending for and describes in detail some of their most popular types.

THE BERLIN IRON BRIDGE COMPANY illustrate a machine shop designed and built by them for the Bridgeport Machine Tool Company. This is but one of the many structures which stand as monuments to the excellence of design and construction of this company.

WARREN WEBSTER & COMPANY describe in a "straightforward little booklet" the advantages gained by installing their system of steam heating.

THE WESTINGHOUSE MACHINE COMPANY publish a list of engine sales for July in one of the smallest countries of Europe, demonstrating quite conclusively its popularity with expert engineers.

THE ELECTRIC APPLIANCE COMPANY are enabled to give their customers the benefit of a reduced cost in manufacture of the famous "Paranite" wire. The reduction is due to the large quantity produced and not to any cheapening of material.

THE CENTRAL ELECTRIC COMPANY are bringing out another novelty in the shape of a reflector.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY call attention to the fact that Habirshaw wires were used in the Siegel-Cooper "Big Store." This only serves to swell the list of large installations for which this company have furnished the wires and cables.

Department News Items will be found in advertising pages.

THE

Electrical Engineer.

Vol. XXII. SEPTEMBER 23, 1896. No. 438.

ELECTRIC TRANSPORTATION.

STATEN ISLAND'S RAILWAY SYSTEM.

The Staten Island Shore.

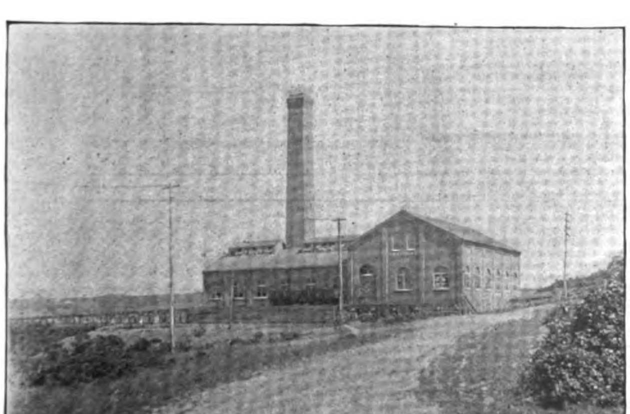
NE more resort is about to be added to the large number already in the vicinity of Greater New York which have been made accessible by the adoption of the trolley system. Midland Beach is the name given to a portion of the southeast shore of Staten Island which is undergoing extensive alterations and improvements at the hands of the Staten Island Midland Railway Company, who are also extending their system to various towns throughout the interior of the island.

Heretofore it would have been impossible to find a spot within a few miles of New York which was so devoid of any transit facilities as was Staten Island up to a year ago, and to this reason alone may be ascribed the almost total lack of development of this island which can boast of more natural beauty than any other suburb of New York.

Somewhat over a year ago the Staten Island Midland Railway Company purchased two small railway lines which had been built previously, and secured franchises for a number of new lines in the interior of the island, all of which are being developed into an extensive system of rapid transit, which will eventually connect all the principal points in the island.

LOCATION OF RAILWAY LINES.

The company's lines comprise at present twenty-two miles of single track, all of which is now in operation. Six and one-half miles of this track is double and work is being pushed on the principal lines which are being double tracked as fast as possible. From the ferry landing at St. George the line

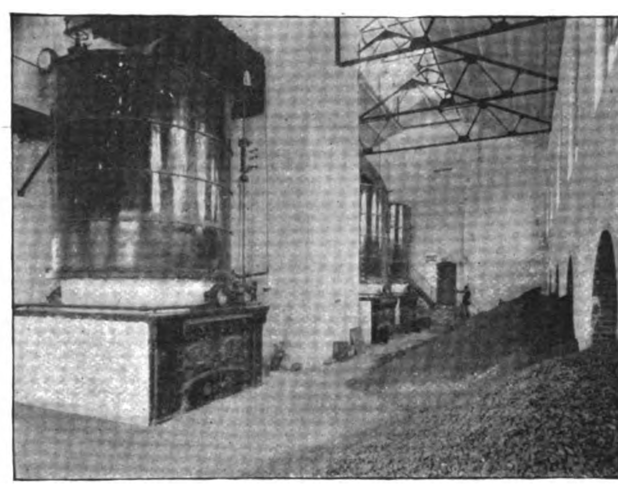


POWER HOUSE, MIDLAND RAILROAD, STATEN ISLAND.

runs to Stapleton and thence by way of Broad street and Richmond road to Concord, where the car house and offices of the company are located. Here the road branches, one line running on the Richmond road to the village of Richmond. From this line another branch turns off opposite the Moravian Cemetery and runs directly to Midland beach. The other line runs from Concord by way of the Clove road and Richmond turnpike to Prohibition Park, and thence on Jewett avenue to connect with the Bergen Point ferry. Crossing the latter line at Castleton Corners is another branch which starts at West Brighton and runs in a southerly direction to Eckstein's brewery. These lines, with the exception of a short distance from Stapleton to St. George, are now in regular operation.

LINE AND TRACK CONSTRUCTION.

The line is constructed partly with span wires and partly with single brackets, the poles being of wood. Three feeders of 500,000 circular mils section run from the power house to the three centers of distribution. The track is laid with 60-pound T rail, except for short distances in passing through villages, where a rail of the girder type was required by the authorities. In such places 90-pound girder rail was used.



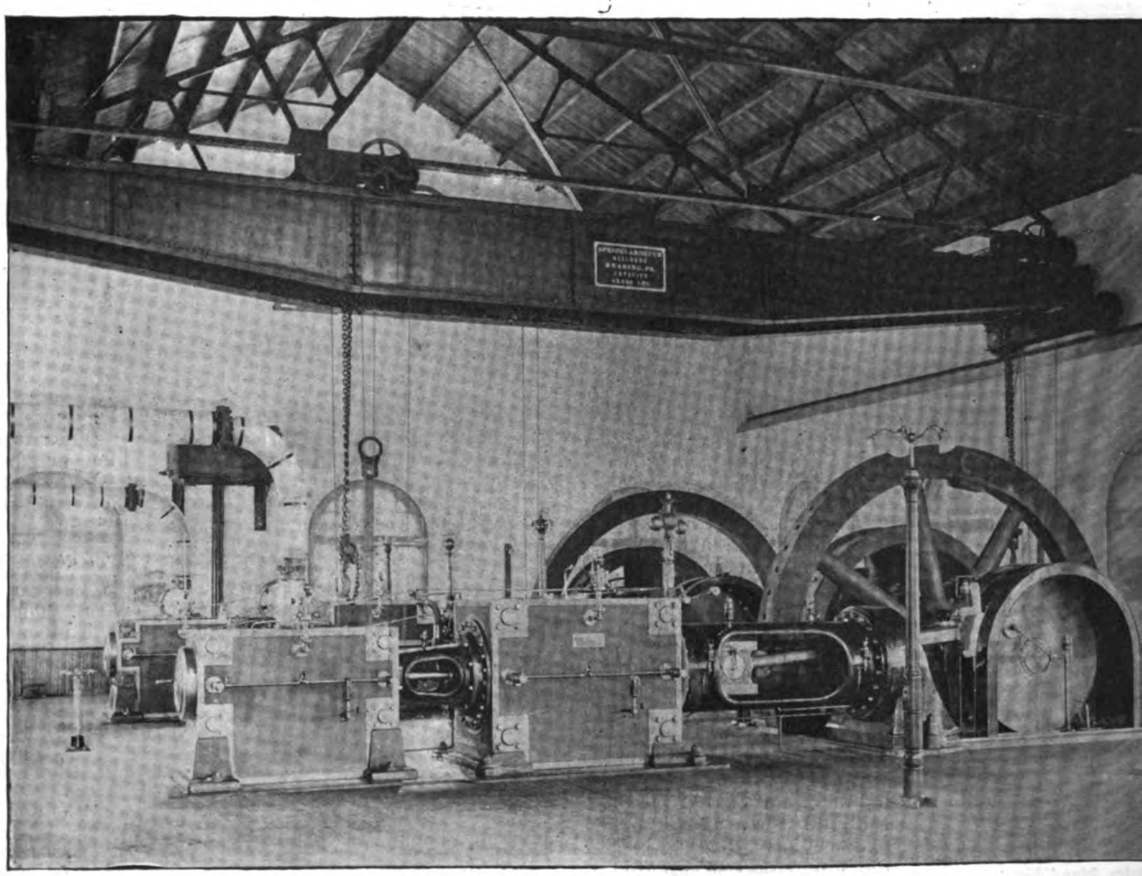
BOILER ROOM, MIDLAND RAILROAD POWER HOUSE.

In order to interfere with driving as little as possible, the plan has been adopted where the roads are narrow, of placing the tracks close to the sides of the road, leaving the center unobstructed. Where this is done side brackets are used instead of span work. Most of the streets over which the company's lines run have macadam pavement which has had to be renewed after the tracks were laid. This kind of pavement has been found to make considerable expense to replace as the large foundation stones cannot be used again on account of their interference with the ties. All the material taken out is replaced with small broken stone.

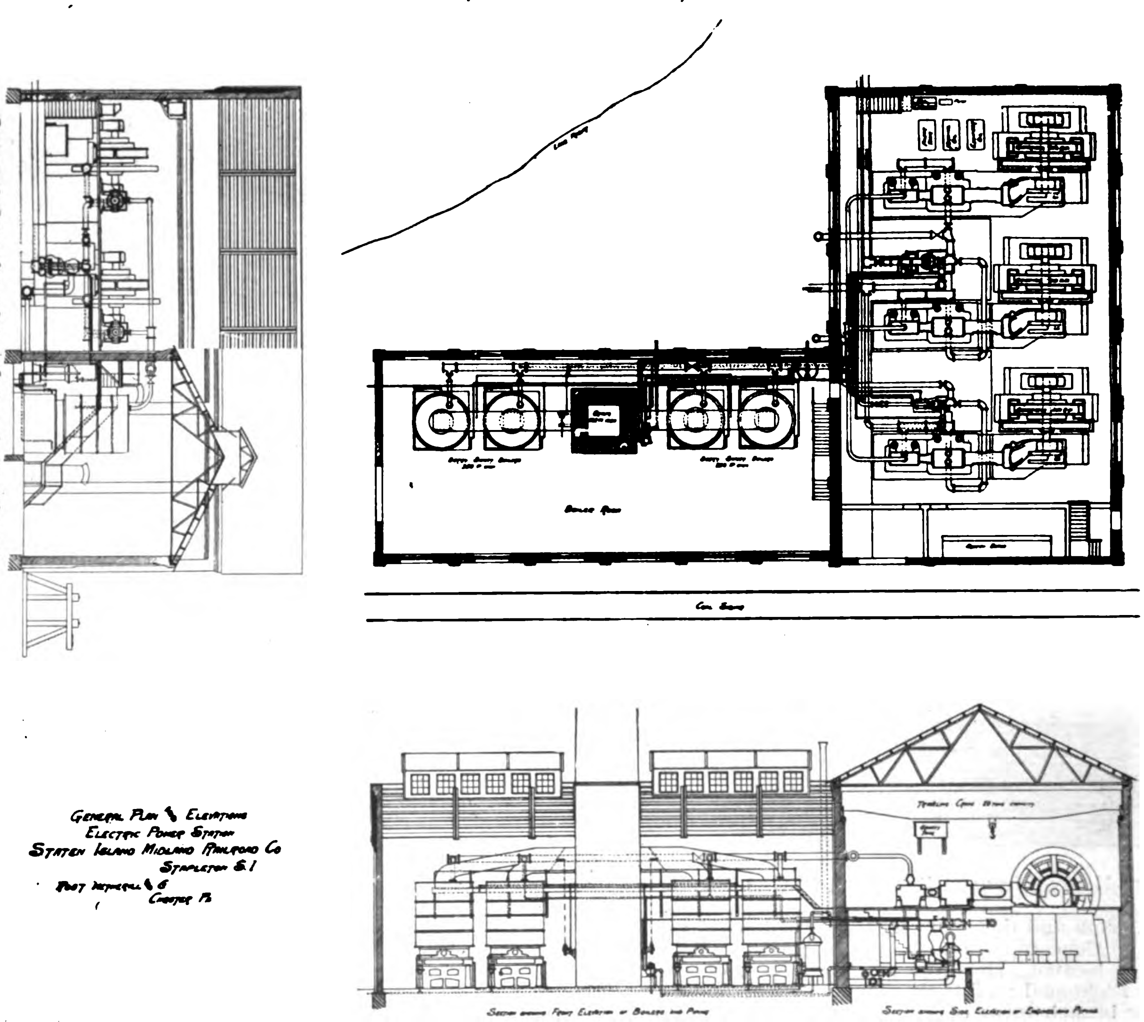
POWER HOUSE AND GENERATING PLANT.

The power house of the company is located a few steps from Grassmere station on the line of the Staten Island Rapid Transit Railroad. On one side is an elevated siding where coal may be dropped from cars directly into the boiler room, and at the rear is a lake of fresh water from which water for boilers and condensing engines is obtained. The power house, outside the advantage of easy access for fuel and water, is especially favorably connected for the economical distribution of current to the different lines of the Midland System, being practically at the center of distribution of power. The general plan of the building and the disposition of the machinery is shown in an accompanying illustration.

The building is of brick, the engine room being 54 feet 6 inches by 88 feet, and the boiler room 39 feet 4 inches by 84 feet. The engines and boilers are from the works of Messrs. Robert Wetherill & Co., of Chester, Pa. They are of the tandem compound condensing type, unusually strong in construction and especially designed to withstand the heavy strains of railway service.



Generating Plant, Midland Railroad, Staten Island.



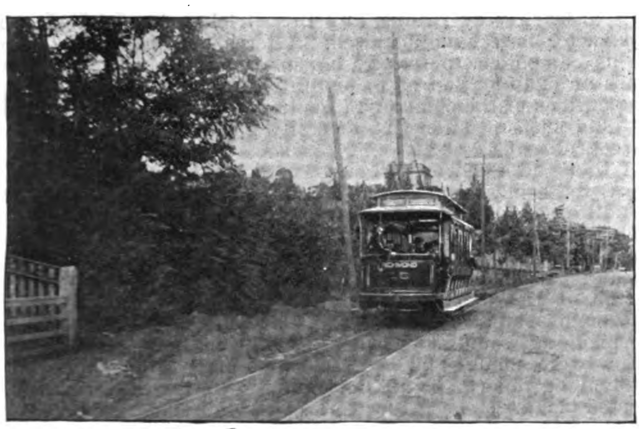
Plan and Elevations, Staten Island Midland Railroad Power Plant,

The cylinder dimensions are 16 inches and 30 inches by 48 inches, the speed being 100 revolutions per minute. The capacity of each at 150 pounds pressure is 500 horse-power, and each engine is directly connected to a 300 kilowatt General Electric six-pole generator. The condensers were built by the Worthington Company, and are located in the basement, which, in this station, is unusually well lighted and ventilated. The piping is of the strongest and most approved construction and is placed with a view to accessibility for inspection and repairs. The main pipes to the engine are of hammered copper and are bent in long curves to reduce the steam friction.

The boilers are an especially interesting feature of this plant. They are of a type rather new in railway work. They are known as the "Berry Boiler" and are manufactured exclusively by Messrs. Robt. Wetherill & Company, and consist of two vertical cylindrical shells, united at the top by a crowned ring and at the bottom by a conical crown-sheet. Tubes radiate from the inner to the outer shell, uniting and bracing them and forming a structure of great strength.

The gases, rising from the fire in the internal combustion chamber, are deflected by a fire brick arch placed in the internal flue, and pass through the tubes to the outside flue, then upward and inward through the middle section of tubes to the internal flue, thence upward and outward through the upper or superheating tubes, thence upward and inward over the top of the boiler to the stack. This boiler has proved remarkably economical in the consumption of fuel and in the attendance required.

The switchboard is of the latest and most approved design. There are three dynamo panels, one for each generator, a middle or totalizing panel and three feeder panels. The totalizing panel contains an ammeter for indicating the total flow of current and a recording wattmeter. The recording wattmeter is an extremely useful accessory to a power station, as it enables the engineer to compare readily during any given period the power output of the station with the coal consumption.



ALONG THE OLD "KING'S HIGHWAY," STATEN ISLAND.

The oiling of all the machinery is accomplished automatically by means of a gravity lubricating system. A large elevated reservoir is located at one end of the station from which pipes run to all bearings. From the bearings it is caused to flow through a filter in the basement to a collecting reservoir, from which it is again pumped up to the feed reservoir. A great economy in oil consumption is obtained by this system.

The station is provided with a twenty-ton traveling crane made by Spiedel & Roper, Reading, Pa. This device makes possible the handling of the heaviest machinery in case of emergency with little or no loss of time.

CARS AND CAR HOUSE.

The company have forty cars, twenty-five of which are long open cars and fifteen box cars. These are equipped with the General Electric Company's 25 horse-power motors and accessories. The car bodies are handsomely finished and were built by the St. Louis Car Company. In connection with their excursion business the company are having a parlor car built, which may be chartered for the use of trolley parties and excursionists. It will be on a smaller scale, exactly similar to the parlor cars on steam roads. The company's new car house which is now in course of construction is located at the Concord junction of the line, which is about at the center of the system. A separate office building is also being erected at this point. The car house is a brick structure 110 feet wide and 300 feet long. It is separated into three distinct sections by two fire walls which run lengthwise through the building. It contains eight tracks, and those in the central section of the building are arranged so as to run entirely over pits.

The entire road is being pushed to completion as rapidly as possible, and before another summer it will have added a new direct excursion from New York, besides providing an excellent system of transit for the residents of Staten Island. The officers of the Staten Island Midland Railroad Company are James C. Hinchliffe, president; B. H. Throop, vice-president; M. J. Wightman, electrical engineer; W. B. Rockwell, treasurer and general manager; E. G. Wightman, secretary.

THE USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.[1]

BY F. O. RUSLING.

WHILE the writer was the superintendent of the Buffalo Railway Company, serious indications of electrolysis of the pipes within a half mile of the power house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems.

Although the pipes were already connected to the negative bus bar by large copper cables, it was found that these were entirely inadequate and that there were two points where the pipes at heavy load were 3 to 5 volts positive to the adjacent rails. One of these points was 1,500 feet north and the other 1,800 feet east of the power house.

The expert calculated that until extensive changes could be made in rail returns, the former point would deliver about 1,000 amperes, and the latter about 3,000. To bring this current to the dynamos with but 5 volts loss would need over $8,000 worth of copper. While hesitating over this large expenditure, it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, center bearing rails, originally weighing 56 pounds to the yard, but worn down to 50 pounds or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was $8 per ton, delivered. Our expert carefully tested their conductivity with 1,000 to 1,500 amperes, using an instrument reading to one-thousandth of a volt in order to secure accuracy. As the showing was satisfactory, he persuaded us to let him try the rails on the 1,500 feet length which would require four rails in parallel to give the desired results. As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back and arranged so that the end of one rail was at the center of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer ¼-inch thick, $1^{3}/_{16}$ inches inside diameter and 4 inches outside, was dipped into hot insulating compound and placed against one rail so as to inclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to bottom of trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement, two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1,500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costing about $25 a ton.

This four rail conduit was connected up and carried at heavy load 1,100 amperes, 1,500 feet with a loss of but 4 volts. This result was so surprising that our expert suspected his instruments were wrong and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct.

To appreciate the magnificent performance of these old rails and their bonds, I need only say that to give the same result it would require 3.55 square inches of copper, and 1,500 feet of this would weigh 20,532 pounds and cost, at 12 cents per pound, $2,462.83. Our four rail lengths weighed 50 tons and cost as scrap but $400. The resistance of steel as compared with copper is usually considered to be between 7 to 1 and

[1] Read before the N. Y. State Street Railway Assoc. at Binghamton Sep. 8, 1896.

9 to 1, but this including 50 bonds in each length was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this even at $30 per ton would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the fourteen rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power house is an air compressor for cleaning out armatures and removing dust from the boiler house walls. An iron pipe was connected from the air reservoir to the yard, and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop.

To avoid drilling the rails, pieces of ¾-inch iron, about 24 inches by 8 inches, were placed in the trough every 15 feet. These were bored at the ends for a pair of countersunk ¾-inch bolts and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼-inch thick, 20 inches by 8 inches. On these more bonds, other layers of four and three rails and finally a ¾-inch by 24 inches by 8 inches top, bolting all layers together. The sides of the trough were but ½-inch from the rails between clamps so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the fourteen rails transmitted 3,250 amperes, 1,800 feet with but 4 volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power house. The rails used in this conduit weighed about 210 tons, which at $8 would amount to $1,680.

It would require 12.48 square inches of copper to equal the 70 square inches of steel. This copper, figured at 1,000 feet by one square inch weighing 3,854.2 pounds, would weigh 86,580 pounds, and at 12 cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3,322, as against $12,852 for equivalent copper. The labor to install the copper would of course be less, but on the other hand, we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2,500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if copper is used for connections. Even when new it is impossible to get the full conductivity of the rail and the contacts get worse and worse as time passes. The copper when covered with the damp earth will oxidize at a rate determined by the composition of the soil and the amount of current transmitted. But following the lines indicated on our second rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost. This subject is well worth careful consideration on the part of railway managers.

HOW CAN WE PREVENT ACCIDENTS AND INCREASE THE GENERAL EFFICIENCY OF EMPLOYEES?[1]

BY W. W. COLE.

THERE are certain accidents which occur upon the best regulated railroads, that can never be averted. They are the results of two agencies: Fate and the fool killer. And there are others which occur through defective apparatus, poorly conditioned motormen, or gross carelessness of employés. One of the first and most important requisites to improving the efficiency of the road and preventing accidents is in the selection of employés, and to this end the application blank is an important factor, and such questions should be asked as to generally outline a man's past.

The question, Do you own real estate or personal property? is important; as a man who has accumulated property while working for small pay, must necessarily be economical and appreciate laws governing the protection of property, and is apt to have care for the property of others.

To what extent are you in debt? I think we will concede that a man who is in debt will not only prove a nuisance to a company, but be apt to take but a short lived interest in his work and become careless. Constant requests are made upon a company to compel a man to back his bills, and a company loses many friends unless such matters are given attention.

Do you use intoxicants, and have you ever been addicted to the use of intoxicants? These questions need no comment.

What are the highest wages you ever received? Now the best man for a place is the satisfied man, who thinks he is doing well. And a man who has commanded higher wages than you pay, is sure to believe sooner or later that you do not appreciate his real value, and he becomes dissatisfied, and will either take more interest in looking for another place, or in airing his troubles before the other men, and he becomes careless in his duties either way.

The other questions are all such as will tend to delineate a man's stability and character. I believe that all men should be placed under at least two hundred dollars bonds, as it not only has a restraining influence upon the men, but so many business men in order to get rid of a man with a little trouble, will give him a first class recommendation, but they will hesitate to go upon his bond unless they know something of his ability, reputation and personal habits. When you employ a man under bonds, you have practically got him registered with his friends' approval.

Great care should be taken in the choice of instructors of motormen and conductors, and to the end it is well to keep a book recording all acts of disobedience or carelessness of each employé and then select as instructor the men as having the best record. It has been my experience that a new man is apt to learn very readily any little tricks of carelessness his instructor may have acquired. After a man has been turned in as competent to run by his instructer, I think he should pass an examination as to his duties, and upon the rules and regulations of the company. I submit examination papers containing such questions as generally apply to the operation of street railroads.

I think all motormen should be furnished with a blank report, to be filled out each evening, or after his run, as to the condition of his car, and report all trouble with breaks or any defects with running gear or apparatus, and place his report on file for the foreman of the shop, who should have an immediate inspection made of the car reported.

One of the most important preventives of accidents is a thorough system of shop inspection, and such reports should be made as would show when a car is in shop, just what repairs were made, and the time and material consumed. A system of reports in all departments that will form a connected chain, to check the work of the individual, is of benefit when such reports are not complicated and are always attended to. I do not claim that such a system will make a good man out of a poor one, as my experience has been that it is much easier, and the result more satisfactory, to discharge the poor man and get a good one in his place, as the process of educating a careless or incompetent man is too much like the horse that fed on excelsior. When he got used to it and relished it he died.

Accidents are frequently occurring from loss of power, when it is most needed. No road from an economical point of view should try to run too close on a theoretical consumption of power. This is especially so in the case of small roads, operating from five to fifteen cars, and is of special significance where there are grade crossings; as in case a trolley flies off, it is apt to be replaced in a hurry with the power on, and this means a sudden jerk, especially on a jump-over crossing; and where a road is running close to its full power capacity, and the power goes off, it is very likely to be several minutes before the circuit-breakers can be kept in and the car got under motion again. When it becomes necessary to reverse a car to prevent an accident, it is very liable to pull the circuit-breakers out at a most critical moment. I doubt if a too slow schedule decreases the number of accidents, as I have found that on a division where the cars run slow the public are inclined to take dangerous risks, rushing in front of moving cars, that they will not take where the cars are moving at a brisk rate of speed.

To prevent accidents and increase the general efficiency of employés, select the employés scientifically and with care; provide a good system for your car inspection and have a surplus of power.

[1] Read before the N. Y. State Street Railway Association, Binghamton, September 8, 1896.—Abstract.

"LIKES IT BETTER." A reader in St. Louis says: "Some few months ago I sent for a sample copy of your paper, which I received and was very much pleased with. I have been taking your paper ever since from a book store. I like it better than the other ten cent papers."

THE BALDWIN ELECTRIC LOCOMOTIVE TRUCKS.

THE axles of the ordinary car truck are not driven, but the truck is hauled by a locomotive. Electric locomotive trucks have driving wheels, and therefore must be adapted to pull cars. This throws quite a different stress on the transoms and necessitates a much stronger and more rigid construction. In order that the motors may be reversible and interchangeable, they must drive the axles at opposite sides of the truck; this produces a distorting stress tending to put the

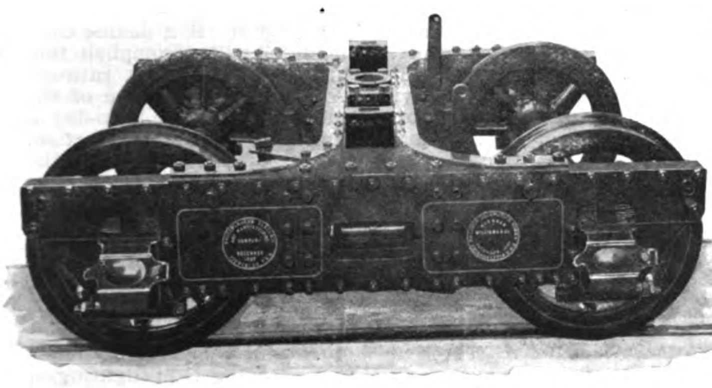


FIG. 1.—BALDWIN ELECTRIC LOCOMOTIVE TRUCK.

frame "out of square." Among the trucks specially designed by the Baldwin Locomotive Works, of Philadelphia, to meet the demands of electric locomotive or motor car work are the two illustrated in the accompanying engravings.

As will be seen, the transoms of the truck are provided with a substantial gusset to the side frame, and knees and brackets are introduced to hold the frame perfectly square and true, and enable it to withstand the distorting stress developed in the truck by the operation of the motors. Care is taken that the boxes and journals shall be of the proper form and size to adequate wearing surfaces, and that they shall be so fitted as to resist properly the shocks transmitted to them without being thrown out of line. The weight of the trucks and motors is supported on the journal boxes by means of suitable springs with limited range of motion. A swing bolster of improved design is introduced to carry the weight of the car; this is connected to the truck by suitable links, and provided with easy-riding double-elliptic springs.

For the purpose of gaining access to the parts of the truck, and for readily removing the wheels, axles and boxes, a swinging jaw may be arranged to form the outer pedestal leg. This is secured to the truck frame by a joint connection, and securely held in place by the pedestal-cap bolt. When desired, it can be lifted, and the released parts removed without taking the truck from under the car. The swing bolster and springs can be dropped down and taken out without disturbing any of the other details of the truck. The brakes are arranged

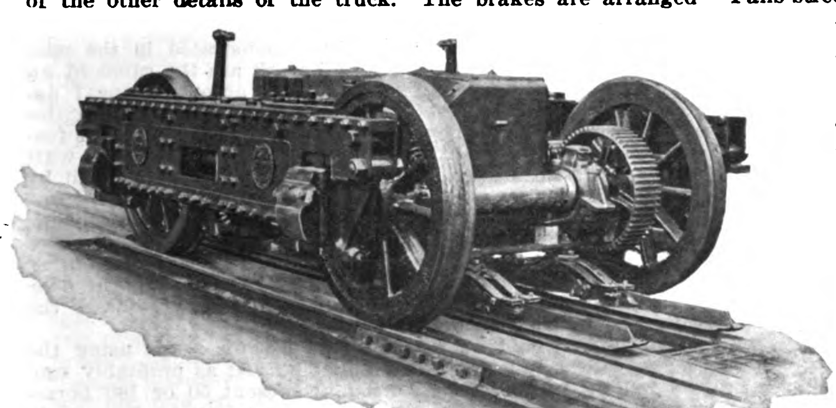


FIG. 2.—BALDWIN ELECTRIC LOCOMOTIVE TRUCK.

without brake-beams, so as not to interfere with the removal of the swing bolsters or motors. The motor hangers are so placed that the motors can be dropped out of the trucks without brake-beams, so as not to interfere with the removal of the swing bolsters or motors. The motor hangers are so placed that the motors can be dropped out of the trucks without taking down the swing bolsters or the brakes, and without removing the wheels or axles.

The workmanship in these trucks is equal to that in steam locomotive construction. All the bolts are turned taper to a driving fit in reamed holes, and all parts are well fitted with planed surfaces.

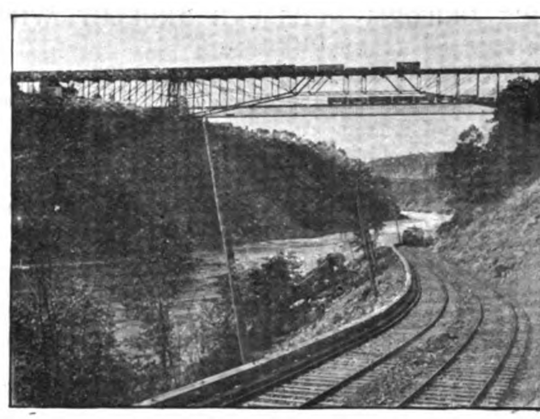
A parallel rod can be provided at small additional cost, if desired, as the strength of the design has been made with this in view. Where it is not desirable to use sand, and where the motors are to be started with full power, it is often best to use parallel rods.

Fig. 1 shows the truck for the Class 8-4-200 E locomotive. It is adapted for use with either the 200 or 100 horse-power motors. The wheels may be made forty-eight inches in diameter without increasing the wheel-base above seven feet six inches.

Fig. 2 shows the truck for the Class 8-4-100 E locomotive. It is adapted for use with either the 50 or 100 horse-power motors. The wheels may be made thirty-six inches in diameter without increasing the wheel-base above six feet.

RECENT TROLLEY WORK AROUND NIAGARA.

THE construction and successful operation of the "Gorge Road" at Niagara is one of the marvels of engineering skill of recent years, while it also displays in no small degree the encouragement given to capital to invest in new projects by electricity. The incorporated title of the owners of this line is the Niagara Falls and Lewiston Railway Company, of which Captain J. M. Brinker is president; F. C. M. Lautz, vice-president; R. W. Jones, treasurer, and H. P. Bissell, secretary. The road runs between the city of Niagara Falls and the village of Lewiston, a distance of seven miles. Not satisfied to



A VIEW ALONG THE NIAGARA GORGE TROLLEY ROAD.

take the beaten paths of travel, this road has been built through the beautiful Niagara gorge.

In Niagara Falls the cars of this road start at the foot of Falls street directly in front of the main entrance to Prospect Park of the State reservation. They run up Falls to Second street, and out Second street to Main over the tracks of the Niagara Falls and Suspension Bridge Railway Company. At the junction of Main and Second streets the "Gorge Road" cars strike their own tracks and continue down Second for one block and then across private property to the point where the road is depressed in order to cross the New York Central Railroad through a cut. Almost immediately upon emerging from this cut the beautiful panorama of the gorge is opened to view. For a distance of about 400 feet at a 9 per cent. grade, the cars descend the bank through a cut in the solid rock fully 75 feet high at the lower end. Then the descent of the slope of the bank commences to the cantilever bridge abutments, the grade being about 6 per cent. for 1,000 feet, 4 per cent. for 2,500 feet and 5 per cent. for 500 feet or more.

It is at the cantilever bridge that the roadbed assumes the level, at which it runs for almost the remainder of the route. This is about twenty feet up from the water's edge. A wooden trestle has been built in front of the bridge abutments, and on this the tracks are laid one within the other, so that only one car can pass this point at a time.

Along the whirlpool rapids below the bridges to the whirlpool, the perpendicular cliff has been blasted away to give the road a foothold, and cribwork has been built at one spot to save the roadbed from the wash of the rapids.

It is only this summer that the road has been operated over its entire length, but it has enjoyed a wonderful patronage. When the road was first operated power was taken from the Niagara Falls Hydraulic Power and Manufacturing Company, but upon the Niagara Falls and Suspension Bridge Railway taking power for the operation of its lines from the tunnel plant, the "Gorge Road" secured the service of that company's station and is now receiving its power supply from it, about 150 horse-power being used. The track is laid with 60-pound Tee-rail, connected at joints with bolt splice bars. At all curves the line is well guarded, especially as it ascends the slope from the cantilever bridge. All the way up the grade there is a double timber guard outside the outer track. The inner of these guards is 6 by 8 inches, while the outer one is 12 by 12 inches. The company now have 20 cars, 18 of which are of the open variety and two of them closed. These cars were made by the J. G. Brill Company, of Philadelphia. In the winter season the open cars are enclosed and heated, and furnish excellent facilities for viewing the winter scenery. The overhead line is of 00 trolley wire, and is divided into sections of about 1,000 feet, with independent circuit breakers. The track is bonded with "plastic" bonds.

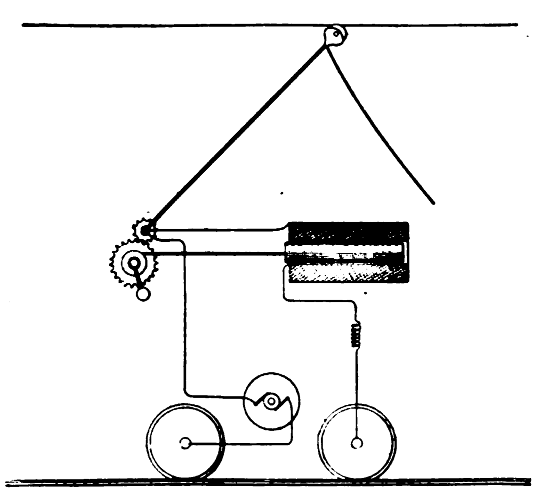
While the cars are thoroughly well equipped for rapid traveling, speed is not an essential feature, for a comparatively slow gait is necessary in order that the passengers may enjoy the full sublimity of the scenery along the line. The construction of the road was very expensive. The right of way had to be purchased, and the natural barriers of the gorge forced an immense expenditure in breaking the roadbed through.

The success the road has had since opening is very largely due to the efficient work of Mr. Joseph K. Brooks, who is its superintendent.

DYER'S UNIFORM PRESSURE TROLLEY WHEEL DEVICE.

It is well known that in the practical working of electric railway cars wherein the current is supplied by an under running trolley from an overhead working conductor a great range of adjustment of the trolley is required, the overhead working conductor being at some points, as in passing under bridges, lowered close to the roof of the car and at other points being elevated to a height of ten feet or more above the car-roof. By reason of this great range of adjustment it becomes desirable to produce means for maintaining the upward pressure upon the trolley which will give a practically uniform pressure throughout the entire range of adjustment of the trolley.

To secure the desired end, Mr. R. N. Dyer, of New York, has



DYER'S UNIFORM PRESSURE TROLLEY.

devised the arrangement shown diagrammatically in the accompanying engraving. This consists of a solenoid located in a circuit independent of that of the car motors. The coil of the solenoid is connected with the trolley through a speed multiplying gear, so that the minimum movement of the solenoid core will be required to effect the adjustment. With this arrangement the maximum efficiency of the solenoid and a nearly uniform pull is secured throughout the range of movement of the trolley.

The solenoid may evidently be replaced by a constant torque motor device.

POWER FROM THE TROLLEY CIRCUIT. IS IT PRACTICABLE? WHY DO THE FIRE INSURANCE COMPANIES OBJECT? WHAT SHOULD BE DONE TO OVERCOME THE OBJECTIONS?[1]

BY H. S. NEWTON.

An experience of several years in the erection and operation of power stations has led me to the conclusion that the chief point of interest connected with them in the eyes of the management is the relative size of their coal bills. In many sections of the country the saving of a ton of coal per day is equivalent to the interest on $20,000. If a device costing, say, $15,000 to install and operate, will accomplish this saving, it is clearly to the advantage of the street railroad manager to install this device. And as a consequence of the realization of this fact, the railroad power station is to-day a combination of all that is economical in steam construction.

It is my intention to first point out to this convention the chief advantages possessed by our railroad systems as producers of power for private consumption and then follow with a statement of the objections raised by the Board of Fire Underwriters and others toward its adoption throughout the cities of New York State. Hitherto the electric light station has figured as the chief factor in the production of power for stationary motors. It is too often hampered, though by circumstances of small units and insufficient reserve to consent to take hold on a large scale of a business necessarily offering what is, as compared with that accruing from lighting, a reduced margin of profit. In lighting stations, too, employing large engines driving many machines, the variation in load always attendant on the use of motors is also objectionable from the fact that the lights are affected to some extent. In these particulars the railroad station is prepared.

Take for example a station in one of our cities containing a 1,200 horse-power direct coupled Corliss engine held in reserve and estimate what could be done with this engine and its attached generator were it thrown into active duty on a private consumer's power circuit. Figure on an investment of $75,000 in the engine, generator, and other apparatus relating to the two. Then assume coal to be worth $3 a ton, and the engine to have a fuel duty of 3 pounds per horse-power per hour, we have coal consumed for each day of ten hours:

Eighteen tons at $3	$54.00
Cost of labor, engineer, fireman, and oiler, say	10.00
Oil and waste	2.00
Incidental repairs	10.00
	76.00
Add to this 10 per cent. depreciation for one day	20.55
And interest on the investment at 5 per cent	10.27
	$106.82

Then figuring on an ability to sell the output for 10 hours in the day at 2¾ cents per 1,000 watt hours, we have 1,200 horse-power for 10 hours equals 8,952,000 watt hours at 2¾ cents equals $246.18.

With cost of production as stated above, the net profit amounts to $139.36, a very fair sum to go toward reducing operating expenses.

I think it has been abundantly demonstrated in the past that long lines of shafting for mill work are the cause of an enormous waste of energy, and on that account alone I am sure that there are numbers of the smaller mills in our cities which would save money if they rented their power at a reasonable rate from the railroad circuit. The recording watt meter has been brought to a high state of perfection, and by its aid there is no necessity for the consumer to pay for one iota of current more than he uses. Then he can divide up his factory among several smaller motors, can run one or all of them as occasion may demand. This, too, with an outlay which should be inconsiderable compared with that the electric light companies would be compelled to charge were the power obtained from their circuits.

This plan would be feasible not only for shops using the very smallest of units, but it might be just as profitably considered by manufacturers using at present 50 or 100 horse-power steam plants and employing their own engineers. At 2¾ cents per 1,000 watt hours, were there 50 horse-power used uninterruptedly during the day, the charge would be a little over $10, while the presumption is that were a small engine and boiler used to move line shafting for the same shop, the inferior economy of the steam plant plus the increased power necessitated by loss in friction would more than overbalance in cost the bill sent in by the railroad company.

The small outlay required from the railroad company in

[1] Read before the N. Y. State Street Railway Association, at Binghamton, Sept. 8, 1896.—Abstract.

reaching consumers is another point to be urged in favor of supplying power from the trolley circuit. It is a noticeable fact that street railroad engineers are providing much more liberally for their trolley feeders to-day than they did on the introduction of electricity as a motive power and in consequence our lines are so well fed that the abstraction of a small percentage of power for outside use would hardly be noticed in the running of the cars. Then the close proximity of the feed wires on the railroad circuits and the short taps and small expense required to connect them to factories would be a strong card in the eyes of the consumer.

The objections as advanced by the Board of Fire Underwriters to the use of the trolley circuit for stationary motors seem to be embraced in one feature, the ground return.

Over in Syracuse we are using for supporting our various lines, some four or five hundred iron poles. Every pair of poles is to the trolley wire suspended between them a dead ground, and yet in the last three years, during which time I held my position on the street railroads there, we have never had one ground on these poles. And yet these insurance men tell us that they cannot find an insulation secure enough to warrant their insuring a building into which the trolley circuit runs, with every precaution taken for most careful insulation, without an addition to the premium such as I have noted.

To bring insurance bosses to our way of thinking and to gain entrance for the trolley circuit into the factories and workshops would seem to be an imposing task. These men have been known to yield to pressure, however, in other things, and there is always the rivalry and greed among them arising from competition to favor an effort in any direction. The power business itself is one that is assuming more importance every day, and with an assured profit in sight, the railroad companies (in this time of three-cent fare agitation) will not long consent to remain without their share of the spoils.

THE DAILY INSPECTION AND CARE OF CAR EQUIPMENTS.[1]

BY JAMES B. CAHOON.

In carrying out a system of daily inspection, or any system for the care of car equipments, we have in view a twofold object: (1) To prevent breakdowns when the car is out on the road, and the consequent annoyance to passengers, as well as the blocking of traffic and the throwing of the cars off their schedule time. (2) The reduction to a minimum of the repairs necessary to maintain the equipments in good working order and the prolongation of their life. We have, then, to, determine how we can best accomplish these objects and in so doing obtain the best results with the least expense.

Considering for a moment what we have to deal with, we find in the ordinary electrical car that we have two motors of fifteen horse-power or upwards, with their various connections, placed in the very worst possible position in which to operate machinery in motion, with occasional sticks, stones, wires, etc., thrown into them, and on rainy days and in the winter time to throw off the mud, slush and water from the wheels, and subjected to wide fluctuations in the power which they must produce under these unfavorable conditions.

In general there are three systems in vogue at the present time, the first being to let the motors take care of themselves until something gives out and then it is replaced and such repairs made as seem necessary at that time. Second, and the one followed by many of the smaller roads, is, when the car comes in at night, to have one or more men examine the boxes to see that they are filled with grease, rub off the commutator, and see that the brushes are not too far gone for the next day's use, and, if they are, to replace them with new ones, examine the trolley wheel and see that that is in good shape and see that the brakes are repaired properly, then the car is washed or wiped on the outside and is ready for the next day's run. Following this, whenever a breakdown occurs, the car is run over the pit and given a thorough overhauling. The brasses, pinions, and gears are examined, and replaced if deemed necessary, and the motor is painted if it so requires and put into fair shape, or, in some cases, it is taken down entirely and thoroughly overhauled.

The third system consists of a rigid daily inspection of the motors, trucks, and car-bodies, in all their parts, everything being gone over by competent inspectors and the car not allowed to go out if any defects exist. This last system seems to be the only one by which we can hope to get perfectly satisfactory results, but it can be elaborated so that the expense would be more than the gain, though as a rule I have not found this to be the case.

The system whose adoption I would advocate is that which we have put in practice on our road and suggested to some other roads, which from actual experience has shown itself to be an eminently satisfactory one. This system is as follows: A trip inspection, a daily inspection and a monthly inspection. The trip inspection may be made in one of two ways: If the car runs into the car barns at the end of each trip it may be gone over by inspectors ready to receive it, who examine the boxes, see that there are no signs of heating, that the grease cups are properly filled, that the armatures and fields are all right and that the brake mechanism is in proper condition. On small roads where cars are not run into the car barns, perhaps, until the end of the day, this inspection may be made by the motorman at the end of each trip, it being a brief one and can be made in a couple of minutes, and if anything is out of order the trouble can be remedied on the spot. To this end, as well as to any repairs en route, each car should be provided with a tool bag containing a small ball pein hammer, a 10-inch monkey wrench, pair of 8-inch pliers, and 10-inch screw driver.

The daily inspection: When cars are run into the car barns after the day's work is over, two inspectors board each car and go over every part of the car and equipment, removing dust and dirt from around armatures and fields as far as possible with a hand bellows, wiping commutator, removing brushes and seeing that they are in good order and the copper peeled back on them so they will not wear into the copper coating during the next day's run, thus avoiding the squeak which this would cause. Every electrical connection is carefully examined to see that it has not become jarred loose and if any defect exists in any part it is immediately repaired, if such repair will not involve over ten minutes' work; if it does, then the car is left over for the machinists to put in order on the following day. The same care is exercised in going carefully over all the nuts, bolts and washers, cotter pins, etc., connected with both motor and truck; brake rods are gone over and brake shoes examined and everything seen to be in proper working condition for the morrow. The car is then turned over to the car washer who goes over the outside of the car, cleaning all parts carefully, the inside of the car being swept out by the conductor who brings the car in, and the conductor who takes the car out in the morning cleans the brass work and windows and dusts off the seats and the inside of the car. In this manner we have caught a great many troubles just commencing which cost comparatively little to fix at that stage, but which, if allowed to continue, would have entailed quite serious outlay.

Third, Monthly Inspection: Once a month in rotation each car is run over the pit and motors dropped down, taken apart and thoroughly cleaned; gears, pinions and brasses, if they are so far worn that they will not last another month, are replaced. The armatures and fields are carefully cleaned and painted and the commutator turned down if necessary; in fact, the equipment is put into first-class order throughout, so that to all intents and purposes, it is as good as new when again replaced on the car. The car-body and trucks receive the same care and attention and are also put into first-class running condition.

We have found by experience that a shoe having sections of harder material cast in it has effected quite a reduction in the cost of brake shoes, the average life of these shoes being about three and a half times that of the ordinary cast iron shoe; these shoes lasting a little over two months on our road, while the old style cast iron shoe only lasted about 18 days.

A comparison of figures on our own road of the two different plans of the careful system of inspection and the old way of letting things go until they go to pieces, shows that the saving effected more than equals the total wages of the men employed on inspection and the machinists employed in the daytime repairing the cars. This, however, would not hold true on a large road, probably, but certainly the saving effected would considerably more than offset the wages of the men on inspection alone, and I believe that a system such as outlined above will, if carefully followed out, accomplish the best results with the least expense.

[1] Read before the N. Y. State Street Railroad Association, at Binghamton, Sept. 8, 1896.—Abstract.

ELECTRIC HEADLIGHTS

As a number of railroads in the United States are contemplating placing electric headlights on the locomotives in place of the present headlights, Theodore N. Ely, chief of motive power of the Pennsylvania Railroad Company, was asked whether his company contemplated doing the same thing, and he said that under no circumstances would the present system of lighting up the tracks ahead of the engine be changed.

In speaking of the use of the electric headlight, he said that the Pennsylvania Railroad experimented with this system sev-

eral years ago, and while it gave an excellent light, it would not answer the requirements, as on a two-track or a four-track road the rays from a locomotive coming in an opposite direction were so strong as to blind the engineer, and it would be some time before he got over it. Mr. Ely also said that of late years they have been reducing the size of the headlights for the locomotives. They were formerly thirty inches, but now are sixteen. Headlight oil, he thought, was more reliable and was cheaper, and he saw no reason for placing a dynamo on the engine for generating electricity for the headlight.—Philadelphia "Press."

AN ORE TROLLEY ROAD FOR CRIPPLE CREEK, COLO.

The arrival of Joseph B. Crosby, of London, England, at Denver, Colo., has brought out the announcement that New York capitalists have completed arrangements for the construction of an electric line for hauling ore from Cripple Creek district to Canon City, also for the erection of two mills and the building of a power plant which will illuminate the town of Cripple Creek and the big mines of that district. The estimated expenditure by that company in this proposed enterprise is $1,250,000.

This company, according to Mr. Crosby, has secured the right of way formerly held by the Canon City, Cripple Creek and Gold Belt Railroad. This road will be constructed at first from Canon City to Gillett, and the ultimate purpose is to push the line to Cripple Creek and beyond. The length of the road is 30 miles and the line will be used principally for the transportation of ore from the Cripple Creek district to mills which are to be erected at Canon City and Marigold by the New York syndicate. Work will be commenced on the trolley line immediately after election.

There will be ten trains daily on the trolley line. These trains will be made up of three ore cars and one passenger car. The hauling of the ore to the mills will be down hill and the promoters of the scheme estimate that but 30-horse-power will be required to operate the trains.

The grade of the proposed road is but 2 per cent. and the construction has been pronounced easy by engineers who have been in the field surveying the route. A good portion of the distance is through an open country.

The company also intends to take in the Bare Hills district, Freshwater camp, and numerous big properties by means of spurs. The rolling stock will consist of about 25 motors, 30 passenger cars and 100 freight cars.

The power to operate the road, as well as to illuminate the Cripple Creek district, will be furnished by an electric power plant which will be located at some point on the Arkansas River which is still kept from the public. This plant, it is estimated, will cost in the neighborhood of $400,000, including the transmitting power to the Cripple Creek district.

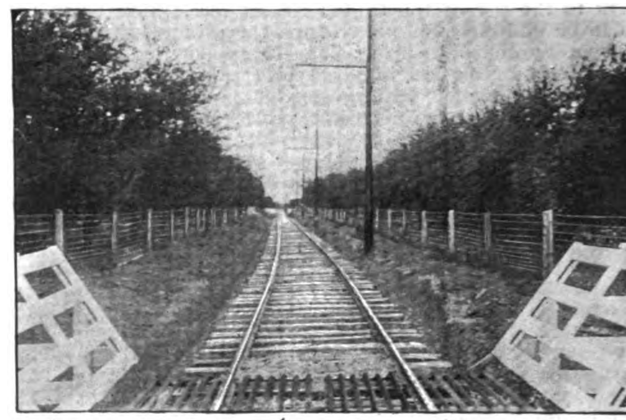
The mill to be erected at Canon City will have a capacity of 100 tons to begin with, and will require an expenditure of about $50,000. The plant will be constructed with the arrangement to increase to a capacity of 300 tons. Workmen will be engaged in constructing the mill while the building of the trolley line is in progress, and will be equipped with the latest improved methods in treatment of ores.

THE LEWISTON TROLLEY ROAD.

BY ORRIN E. DUNLAP.

NOW that the Lewiston and Youngstown Frontier Railroad is in operation, one can board a trolley car on the shore of Lake Erie, in Buffalo, and travel over electric lines from lake to lake, or, in other words, from Lake Erie to Lake Ontario. The three electric lines that make this really delightful trip possible are the Buffalo and Niagara Falls Electric Railway, the Niagara Falls and Lewiston Railway and the Lewiston and Youngstown Railway.

The Lewiston and Youngstown Frontier Railway connects the two pretty villages whose names have been incorporated in its title, but it is quite likely that the road will become better known as the "Old Fort Route," owing to the fact that it runs in close proximity to old Fort Niagara, the historic military post at the mouth of the Niagara River. In length this new road is seven and one-half miles, but an additional mile is to be built next spring to connect the road with a magnificent grove of white oak timber owned by the railway company on the shore of Lake Ontario adjoining the military reserve on the east, which is to be devoted to pleasure resort purposes. The road is a single track line, a 68-pound rail being used in its construction. From end to end the road is rock ballasted, the company owning the right of way, which is 30 feet wide. The Lewiston end of the line is in close proximity to the dock of the Niagara Navigation Company, where boats are taken for Toronto and down the St. Lawrence, and also adjoining the New York Central depot, where trains are taken for all points. From this point the road runs up into the village of Lewiston and when about 40 rods back from the river turns toward Youngstown, passing through many fine farms and beautiful orchards, as will be seen by the illustrations in connection with this article. Approaching Youngstown, the road is again diverted toward the river and runs through the principal street of the village close to the river bank, affording occasional beautiful glimpses of the scene where river and lake meet.



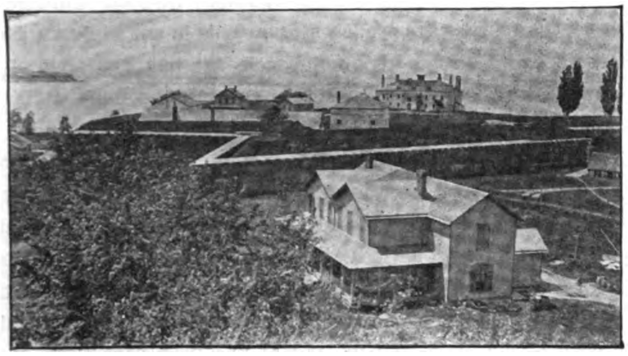
TROLLEY ROAD THROUGH A NIAGARA APPLE ORCHARD.

The contractors who built the road were Messrs Crage & Tench, while the electrical equipment was furnished by the F. W. Oliver Company, of Niagara Falls, their electrical superintendent being Mr. W. L. Adams. In both the villages mentioned the overhead construction is of span work, and on the line of the road through the country bracket construction is used. The trolley wire is 00, and was furnished by the Crefeld Electrical Works of Rhode Island. The power for the operation of the line is purchased of the Niagara Falls Hydraulic Power and Manufacturing Company, whose generating plant is on the canal basin in the city of Niagara Falls. To supply this power a 500,000 cm. cable is run down through the gorge on the poles of the Niagara Falls and Lewiston Railroad to the terminus of the line at Lewiston,

ROAD TERMINUS AT MOUTH OF NIAGARA GORGE.

and from this point a 0000 feeder runs 2,400 feet down the road toward Youngstown. Beyond this toward Youngstown the trolley acts as the feeder, the distance being about three miles. This makes about seven miles of the 500,000 cm. cable and about the same amount of the 00 wire. Thus it will be seen that the Youngstown end of the line is about fifteen miles from the plant which generates the motive power. The generator used was made by the General Electric Company, and is 90 kilowatt. To improve the service a second generator, which works in series with the first generator, is used as a "booster." This "booster" makes 750 revolutions per minute, and is found of great assistance in the matter of voltage. The voltage at the generator is 550, which the "booster" raises up so that the voltage at Lewiston is 580. Between the first generator and Lewiston the loss in voltage is about 250. The voltage at

Youngstown, about 15 miles from the generating plant, is 507. Mr. Frank G. Lott, the new superintendent of the Buffalo and Niagara Falls Electric Light and Power Company, is also in charge of the power plant of the Niagara Falls Hydraulic



FAMOUS OLD FORT NIAGARA ON THE LEWISTON TROLLEY ROAD.

Power and Manufacturing Company, which, as stated, furnishes the power for this road.

The president of the Lewiston and Youngstown Frontier Railway Company is Mr. L. D. Rumsey, of Buffalo, who has a beautiful summer home on the Niagara midway between Lewiston and Youngstown, and Mr. R. B. Goodman is superintendent.

POWER TRANSMISSION.

THE PIONEER TRANSMISSION PLANT, OGDEN UTAH.

THE Pioneer Electric Power Company, of Ogden, Utah, has within the past month placed a contract with the General Electric Company for a complete 5,000 horse-power, three-phase plant, covering a transmission of thirty-six miles, from Ogden to Salt Lake City.

The power will be obtained from the fall in the canon of the Ogden River, at a point almost within the limits of the city of Ogden. Across the head of the Ogden Canon a dam is to be thrown, and an immense storage reservoir formed, which will cover some 15 or 20 square miles of a valley in the mountains. From this dam to the power house is a distance of nearly six miles. The water will be carried through a six-foot pipe of wood for about five miles, while for the rest of the way it will pass through a six foot pipe of rivetted steel. These pipes are fitted at intervals with automatic relief and air valves to prevent the bursting or collapsing when the flow of water is varied by changes of load. The effective head of water at the power house will vary from 400 to 450 feet and the full capacity of the pipe line will be 10,000 horse-power.

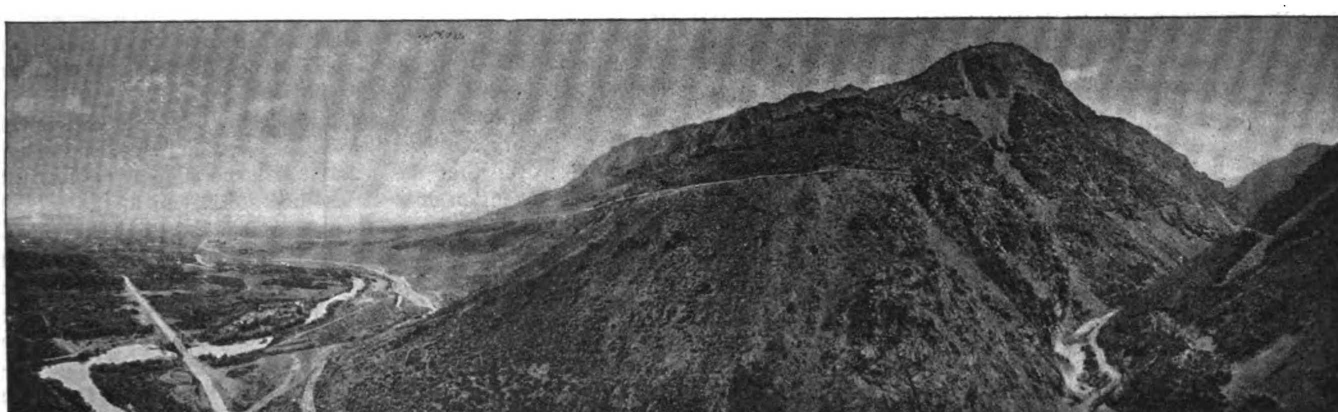
Two duplicate receivers will be used, one at each side of the power house so that either can be shut down without stopping the plant. To these the pipes running to the water wheel nozzles will be connected. The speed of the wheels will be controlled by Knight governors and the valves will be operated by hydraulic pistons so that the generators may be stopped and started from the switchboard. The water from the wheels on each side of the power house will pass into a central tail race under the floor between the two lines of generators and will be conveyed into canals for the irrigation of some 18,000 acres of land in the vicinity of Ogden, which will be reclaimed for farming purposes.

The electric plant at first will consist of five 1,000 horse-power 24-pole, three-phase generators, driven by Knight water wheels running at 300 revolutions per minute. The water wheels and fitting will be furnished by the Risdon Iron and Locomotive Works, of San Francisco. Water wheel and armature are mounted on the same shaft, and are supported by the same base frame and bearings. The periodicity of the current is 60 cycles per second and the generators will be wound for 2,300 volts. The exciters, each of 100 kilowatt capacity, direct connected to their own water wheels will be provided, either of which will suffice to excite the fields of all the generators in the completed station. The current from the generators will be carried by lead covered cables laid in ducts between the generator foundations and the wall of the building, to the generator switchboards at one end of the power house. The boards will be blue Vermont marble panels and will be completely equipped with all the necessary controlling and regulating instruments and apparatus. Tachometers on the switchboard, operated by synchronous motors electrically connected to the generators will indicate the speed of the machines.

The step-up transformers and the 2,000 and 15,000 volt feeder panels will be placed in a gallery erected over the generator switchboard. The transformers, nine in number, each of 250 kilowatt capacity, will raise the generator potential from 2,300 volts to 15,000 volts, at which pressure 2,000 horse-power will be transmitted to Salt Lake City. The local distribution of the balance at Ogden will be made at 2,300 volts.

The transmitted current will pass over six No. 1 wires strung on insulators of a special porcelain developed by the General Electric Company, to withstand high potentials, and be delivered to nine 250 kilowatt, step-down transformers at Salt Lake City, which will connect it at 2,300 volts for distribution.

The transmission line and transformers will be arranged to allow of the use of a potential of 25,000 volts. This will permit of the efficient transmission of current to the mining regions of Mercur and other camps thirty to thirty-five miles beyond Salt Lake City. All lines will be protected by the latest types of General Electric lightning arresters, which have proved so efficient in other transmissions.



FLUME FOR THE PIONEER POWER TRANSMISSION, OGDEN, UTAH.

The flume is seen passing high up across the face of the mountain and dipping to the valley on the left.

To construct the iron and wooden pipe bringing the water to the wheels, motors of 100 horse-power are set up in the shops of Rhodes Brothers, in Ogden, supplying extra power for the work which is one of the most extensive pipe line contracts ever undertaken, five miles of six-foot wooden stave pipe, and one mile of six-foot rivetted steel pipe. Practically all the work will be done on the ground, the steel being received in flat sheets to be rolled, punched and riveted in the shops, and lumber for the wooden pipe in the rough to be milled, planed and put together on the spot.

Salt Lake City, with the completion of the Pioneer plant, will receive power from two of the most important electrical transmission installations ever undertaken. That transmitting the power from the Big Cottonwood Canon, already described in The Electrical Engineer, has only recently been completed, that of the Pioneer Company will probably be inaugurated about the first of November of this year.

THE

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CONTENTS.

MOTORCYCLES.

THE details given in our last issue as to the horseless vehicle races at the Rhode Island State Fair, go to show that the contest was far better organized and far more satisfactory than any of its predecessors. This is not saying a great deal, perhaps, but as the motorcycle art has depended upon these races to show the public what could be done, it is desirable that the conditions should be of the right kind. At Chicago, last November, the race took place on soft park roads, under heavy snow and slush. In New York this year, the "race" was along crowded city streets and rough country roads and a "newly plowed golf ground," and the competitors were refused permission to traverse the firm roads of Central Park. At Providence, there was a perfect race track, off which the crowd was kept, and instead of one long race there were laid out five heats, one each day, and each of five miles. Under these circumstances, the Duryea gasoline motor which won the $3,000 prize in New York, was badly defeated, and the honors went to the two electric vehicles, one of which made its fastest mile in 2 minutes 13 seconds and the other of which made its fastest five miles in 11 minutes 27 seconds. These speeds figure out at from 25 to 30 miles an hour, a remarkable showing.

The question arises naturally as to what these races are worth, outside of arousing public attention and tickling public curiosity, and it is hard to give a reply other than condemnatory; while we find among competitors and inventors a strong feeling of distaste and a prejudice against races, in which their new vehicles are now used simply as a drawing card. Experiments and traveling are costly, and a few hundred dollars in prizes do not go very far, even if one wins. It must be this which accounts for the few entries. Each time, the entries have been small and the actual starters a disappointing fraction of the entries.

The motorcycle art is certainly advancing, but it would go ahead more quickly if the objects to be aimed at were better understood. There appear to be two classes of vehicles to be worked out, one for long distances, the other for short. In the first category the electric vehicles have no place, and it has yet to be proved that the demand is large enough to make it worthy the attention of electrical inventors. As to the second class, there is little doubt of an early demand, both for pleasure vehicles and for light business and express wagons. But it does seem as though the batteries must be lightened in some way. The weight and space of the battery equipment do not appear to be commensurate with the work to be done or the size of the motors to be driven. On a level country, lighter batteries might serve, and in a hilly locality, it might be possible to let the motors do a little generating on the down grades. But the present huge masses of battery, said to be good for 50 or 100 miles, mounted high in the air on light running gear, do not strike us as altogether the best outfit, for business purposes.

THE TELEPHOTIC PROBLEM.

SOME of the most ancient records and traditions in existence hint at the possibility of persons, separated by long distances, communicating with one another; and the speculative philosophers of the Middle Ages never tired of ringing the changes on this theme. And, indeed, at least one among them came very close to the general idea of the needle telegraph, though, of course, all essential operating detail was lacking. The telegraph, the cable and telephone have fully realized all these dreams, but in their place there has arisen another of a character designed to call forth the highest inventive faculty and mechanical precision, and that is, if we may use the expression, "seeing by wire." To convey or reproduce a picture by the well-known fac simile telegraph systems sets up relatively few difficulties, but to convey directly to the eye of the observer a picture of an object or scene at the other end of a wire is quite a different matter, involving factors entirely different from those in the fac-simile telegraph. One element, however, where but a single wire is employed in the transmission, seems to be common to both methods, and that is, synchronism in the working apparatus at both ends of the line. So far as this element of the combination is concerned the alternating synchronous motor ought to afford a rigid consonance between station and station, while Mr. Delany's synchronous telegraph apparatus will also be recalled in this connection. But how to convey the varying effects of light and shade, to say nothing of colors, is not by any means beyond the province of speculation. Naturally the peculiar properties of selenium at once suggest themselves as a medium for producing electric current effects and many ingenious ideas have been put forth based upon them. The latest addition to the list of these is the scheme of Dr. Huber, who for the first time introduces the Röntgen ray as an auxiliary at the receiving end. We do not pretend to say that the method described in another column is feasible as it stands, but as a basis for further work in this direction it may well bear study. Thus far only the one wire transmitting systems of this class have been considered, but in a recent interview Mr. Tesla is quoted as having under consideration a multiple wire system. As to the other details Mr. Tesla did not vouchsafe any information; but we hope that, having cleared the deck of other noteworthy things already in process of perfection, he may soon be in a position to give the world in practical shape, one more of the brilliant ideas that have brought him fame.

A TAME CONCLUSION.

FOR some time past, the daily press has been predicting war. We do not refer to the troubled state of affairs in Europe due to the infamous massacre of Armenians; nor to the dispute over the Venezuelan boundary; nor to the desperate condition of poor Cuba; but to the expected rivalry between the Western Union and American Bell Telephone Companies, on the expiration of their old contract in November. There have been rumors of all kinds afloat, but they ought to be laid to rest by the interview in which Mr. G. C. Hubbard has outlined the real situation. We quote the bulk of his remarks on another page; it will suffice to note here that ehe predicts peace, adding this as a clincher: "The rumor that we will enter into direct and violent competition with each other is entirely without foundation. So is the report that the Bell Company will consolidate with the Western Union. The subject has not been discussed on either side."

This last sentence is a little surprising, but no good reason is known for not accepting Mr. Hubbard's remarks as broadly true. At the same time his statement that there are 6,000 Bell stockholders, does not carry with it the implication he suggests, namely that it would be difficult for any one to buy a controlling interest and thus bring about a consolidation. There are perhaps as many shareholders to-day in Western Union, but the big blocks on either side dominate, so far as being a majority interest is concerned. A third party might step in and harmonize both by owning the controlling interests; and it is rather curious that just at this juncture it should be hinted that Mr. George Gould may sell out his Western Union Stock to Mr. Vanderbilt, while on the other hand, Mr. Morgan, always a Vanderbilt ally, has been buying Bell stock heavily, up to 25 per cent. of the total issue, it is alleged. It will be noticed that some such arrangement would not contradict a word that Mr. Hubbard has said, and would harmonize matters, while leaving each company free to manage its own affairs in its own way. All this makes it the more interesting to know what Mr. Hubbard's "secondary agreement" is likely to be. A tame conclusion anyhow is indicated, rather than a state of violent war.

THE USE OF ELECTRICITY IN THE NAVY.

WE begin in this issue the re-publication of an important and exhaustive treatise by Lieut. Bradley A. Fiske, which appears copyrighted in the "Transactions of the Naval Institute." We have obtained consent for the appearance of this article in our pages, and are glad to be able to place before our readers this latest word on a subject now occupying so much attention both here and in Europe. Lieut. Fiske, who has been attached recently to the War College at Newport, is well known as an electrical expert and inventor, while his naval duties necessarily acquaint him with many aspects of the work that are wholly unfamiliar to the layman. We are indebted to the "Transactions" and to the U. S. Office of Naval Intelligence for the cuts made specially to accompany the article.

LITERATURE.

ROENTGEN RAYS AND PHENOMENA OF THE ANODE AND CATHODE.—By E. P. Thompson and Prof. W. A. Anthony. Cloth 8 vo., 105 illus. 190 pages. New York. D. Van Nostrand Co. Price, $1.50.

This book is a striking evidence of the tremendous activity evoked by the news of the discovery made by Prof. Röntgen, but what is perhaps even more interesting is the data brought forward as to the anticipatory work without which the existence of the X-ray would not have been detected. As a digest of innumerable and often suggestive experiments, the book is invaluable. Mr. Thompson's work has been done with great industry, while the association with him of Prof. Anthony is a double assurance that the review of physical fact and theory is sound, a thing that is especially necessary in a volume that embraces so much that is still conjectural and inferential. The book is not only complete in its record, but in the illustrations that accompany the text, and the whole constitutes a work that must be in the hands of every physicist, electrician and therapeutist.

ENGINEERING CONTRACTS AND SPECIFICATIONS. By J. B. Johnson, C. E., New York, 1895. Engineering News Publishing Co. 417 pp., 6 x 9 inches.

The work is written to serve the purpose of a text book on the law of contracts and engineering specifications. The former subject is treated in a rather brief style in the early part of the book, and can serve only as a general guide to the fundamental principles of the subject. As the author states, this part of the book is intended to serve rather as a cautionary warning aganst legal entanglements than as a guide through any such difficulties. In other words, it chiefly instructs the engineer what not to do. Part II. of the book treats of the style of drawing up engineering specifications and accompanying documents; Part III., of specific descriptive or technical clauses in specifications; and Part IV. gives illustrative examples of complete contracts and specifications. In these last three parts of the book, the information given is suggestive and covers the ground under consideration perhaps as well as can be done within the limits of a single volume.

MISCELLANEOUS.

ALTERNATE CURRENT TRANSFORMERS.—VI.

BY DR. J. A. FLEMING, F. R. S.

Next, with regard to magnetic leakage, it is important to employ some test to ascertain whether there is a large magnetic leakage. Magnetic leakage, as already explained, is due to an escape of induction, linked with the primary circuit, and which does not entirely pass through the secondary. It is promoted by any separation of the primary and secondary coils, as in Fig. 44, but is not entirely eliminated by any arrangement of them, as may be seen by considering the diagrams in Fig. 45. This leakage, of course, can be ascertained by measuring the secondary drop as described above, and comparing that value with the total copper drop as calculated by the rule already given. An experimental proof of magnetic leakage can be obtained by a simple method due to Mr. Mordey. Two thermometers are taken, one filled with mercury, and the other filled with alcohol. These thermometers are compared to see that they are in agreement at the ordinary tem-

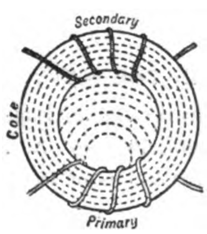


FIG. 44.

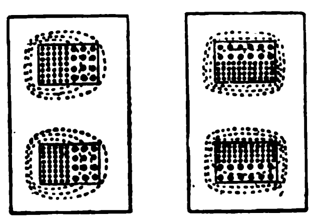


FIG. 45.

perature. The bulbs of the thermometers are then introduced into any portion of the transformer near the secondary coils and kept there for some time. If there is any leakage of magnetic induction outside the secondary circuit, this induction passing through the mercury thermometer will generate heat in the mercury and cause the mercury thermometer to rise, but the spirit thermometer will be unaffected by this process. Hence, although both thermometers will rise from external temperature, if the mercury thermometer rises more than the spirit thermometer it indicates the presence of magnetic leakage at that spot where the bulbs are placed. In some transformers magnetic leakage is actually encouraged. A transformer, designed by Elihu Thomson, intended to give constant currents from the secondary circuit when the primary circuit is worked off a constant potential circuit, is constructed as shown in Fig. 46. In this case there is a kind of iron bridge, interrupted by an air gap across the core between the primary and secondary circuit; and across this bridge, or air gap, induction is forced as the secondary current increases. This leakage, therefore, diminishes the electromotive force in the secondary circuit, and that effect tends to keep down the secondary current, and hence, to preserve it at a constant value. Such a transformer can, therefore, be employed to work arc lamps in series off a constant potential primary circuit. The secondary drop is found to be affected to some degree by the nature of the alternators on which the test was made. A peaked primary

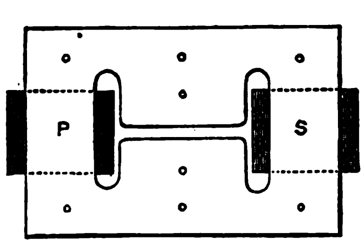


FIG. 46.—THOMSON-HOUSTON CONSTANT POTENTIAL TO CONSTANT CURRENT TRANSFORMER.

e. m. f. curve gives a greater leakage drop than one with a more rounded form. In general, however, magnetic leakage is a thing to be discouraged, and every specification for transformers ought to contain a clause defining and limiting the amount of secondary drop. One convenient way of doing this is as follows: Suppose the standard secondary electromotive force to be 100 volts, and the primary electromotive force 2,000 volts, then the specification should define that when the transformer is working on a constant potential primary circuit of 2,000 volts, the secondary terminal potential difference on the transformer should be 100 volts at half load. At full load the secondary potential difference should not be less than 98½ volts, and at no load should not be greater than 101½ volts. In this manner the unavoidable secondary drop is, as it were, distributed half up and half down, and is not so much felt on the lamps as if the transformer gave its standard electromotive force at no load, and then experienced the full effect of the drop when loaded up to full load. Also in a specification for transformers the manufacturer ought never to be allowed to produce a high efficiency at the expense of a large secondary drop, but such a definition of the core loss and copper loss ought to be given that he is bound to produce an all-round excellence. As a sort of guide to the kind of figures which may be obtained by good makers in actual practice, the following table may be taken as representing the secondary drop and core loss in transformers of these various sizes. These figures may be taken as a kind of indication of the core loss and secondary drop, which can be obtained in good modern practice in the construction of transformers. Some makers may be prepared to do better than this; but exceedingly small iron core losses ought always to be looked upon with a certain amount of suspicion, the important question being, not how low can the iron losses be made, at first, but how long will they keep low when the transformer is being used; and this, as above stated, can only be determined by careful tests, made at intervals, as the transformer ages:

Size of transformer defined by full secondary output in watts.	Allowable iron core loss on open secondary circuit in watts.	Allowable secondary drop in per cent. of normal secondary electromotive force.
750	20 to 23	3
1,500	36 " 41	3
2,250	43 " 50	3
3,000	49 " 57	3
3,750	62 " 71	3
4,500	65 " 74	2¾
6,000	75 " 87	2
7,500	88 " 101	2
9,000	105 " 121	2
10,500	115 " 133	2
12,000	121 " 139	2
13,500	138 " 155	2
15,000	150 " 172	2

ELECTRICITY IN NAVAL LIFE.—I.

BY LIEUT. B. A. FISKE, U. S. N.

$1,500,000,000 is the amount stated by The Electrical Engineer, after a careful investigation, to be the capital invested in the United States in the various electrical arts, such as the electric light, telegraph, telephone, electric railway, etc., etc. In examining the causes for the investing of so large a sum, we must conclude that either the people in the United States are a very unwise and visionary class, or else that electric appliances do really possess some qualities which contribute to their comfort and happiness in a practical way.

In examining the results of the use of electricity in naval life, we must admit that, up to the present time, electricity has fulfilled all the promises it has given us. It has made our ships brighter, cleaner and healthier; it has lightened the task of enforcing discipline; it has increased the accuracy of gunnery; it has made instruction interesting; it has assisted the surgeon in diagnosing wounds and relieving pain; it has given the captain better control of his ship, and the admiral better control of his fleet; it has added an element of intelligent interest and expectation to each new addition to our Navy, and it has brought into active sympathy with the sea-going class a large and influential body of progressive men on shore.

The enormous development of the use of electrical appliances in all countries of the civilized world, and the beneficent effects resulting, are bearing practical fruit in naval life. The experience gained by electric railway companies, electric light companies, telephone companies, telegraph companies, and all the other thousand and one branches of business in which electricity is used, has proved that electrical apparatus may be relied upon provided two conditions are fulfilled. The first condition is that the electrical apparatus shall be designed to meet the particular circumstances of each case; the second is that it shall be cared for by men who understand it. The increasing confidence shown in it by naval authorities has been particularly evident in France, where numbers of ships have been constructed in which electric power is used to do almost all the work heretofore done by auxiliary steam engines.

The principal difficulty that electricity has had to meet in our Navy has been the fact that there has been very little incentive for officers and men to study it; so that most of those who have become proficient (enlisted men as well as officers) have gone into civil life, and we find them distributed among the various colleges and electrical enterprises of the land.

There they are doing good work for the country and are making honorable reputations for themselves, but, so far as helping the Navy goes, their services are lost. So it is not surprising that electrical apparatus has come into use in the Navy so much more slowly than it has come into use in civil life; but it is surprising that it has come into use so rapidly as it has, and exhibits a more progressive spirit than seamen are usually credited with possessing.

It is frequently stated that the reason for the slow progress of electricity in naval matters is the difficulty of meeting the conditions of ship life; but this position is hardly tenable, because the conditions for the use of the electric light, electric motors and telephones in warships are in reality not nearly so severe as they are in hundreds of positions along the coasts of the country and through the long stretches of the mountainous and comparatively unpeopled sections of our western lands. In reality there can hardly be found, outside of the college laboratory, conditions which are in many respects so favorable as those to be met on board a modern warship. In the first place, the distances through which the electric current are to be transmitted are extremely short; in the second place, the item of expense does not control to so great a degree as it does in the operations of commercial life; in the third place, in case of any accident or derangement, the place where this accident or derangement occurs is always within a few feet of somebody, so that it will not have to be hunted for, as freqeuntly happens with apparatus on shore, through miles of country; in the fourth place, the solidity of the structure of a ship and the excellence of all of the mechanical appliances are in great contrast with the flimsiness of the structure and the cheap character of the installation which have, for financial reasons, in many cases to be made on shore.

About ten years ago the writer had occasion to deliver a lecture before the Franklin Institute, on Electricity in Warfare, and about four years later, another on the same subject. In the first lecture the operations of electricity in warfare were almost wholly hypothetical and promissory. In other words, the effort of the lecturer was to point out what electricity might be made to do, perhaps. In the second lecture he was able to state with some positiveness that some things could be done and, in fact, that some things had been done. In the present paper he takes pleasure in stating that certain things have actually passed official tests in sea service, and he will confine himself to facts without indulging in any flights of the imagination. To emphasize the difference between the state of affairs obtaining now and the state of affairs obtaining at the time of the first lecture, it may be said that at this first lecture there were present a commodore and a captain of the United States Navy, both officers of high ability and character, and, in a conversation after the lecture, they pointed out the impossibility of using the electric light on board ship by reason of the impracticability of getting sufficient space for the dynamo. In spite, however, of the successful efforts of the Genius of Electricity in ameliorating the conditions of shipboard life, there are still many objectors, and it is a fact that a contest is going on between electro-mechanical and other mechanical apparatus in very many of the important operations in ships and forts, which promises to be as lasting and as bitter as the contest between steam and sails; and yet it is easy to one who watches the drift of modern engineering practice to see with which the ultimate victory will reside. Just now the fight is going merrily on, and the public benefits by the competition. No sooner does an electrical device score a success than some ingenious person does the same thing with mechanics; and no sooner does an important mechanical invention accomplish some new thing than an electrician throws it altogether into the shade by a novel use of electricity. It may be stated as a general law—but with the distinct understanding that it is only general—that mechanical appliances have the advantage of greater simplicity of principle, and that electrical appliances have the advantage of greater simplicity of operation. To paraphrase this statement, mechanical appliances are more easy to understand, but electrical appliances are more easy to use. Mechanical appliances require less instruction for their use; electrical appliances render available a higher grade of intelligence and also require a higher grade of intelligence. Electrical appliances strive for an idea; mechanical appliances do what is required at the moment. The advantages of maturity and experience are on the side of mechanical apparatus; but youth and the promise of the future reside with electricity. Mechanical appliances are less apt to deteriorate from disuse; electrical appliances are less apt to deteriorate from use; mechanical connections are liable to give out under the sudden strain of emergency; electrical appliances, from their nature, suffer little strain in use and are not apt to fail in emergency if found to be in good condition before the emergency occurs. A mechanical connection, if broken or injured, gives plain sign of the whereabouts of the trouble, but the trouble is with difficulty repaired. A trouble in an electrical connection is sometimes hard to find, especially if the apparatus is not thoroughly understood, but when found, is remedied with ease. The difficulty of repairing a break or disarrangement of a mechanical appliance, caused by a stress, is usually in proportion to the greatness of the stress; but with electrical appliances, the cause of trouble is usually minute, and can be repaired as soon as found.

A very important enemy of electrical appliances on shipboard has been the "fatal facility" with which bad electrical apparatus can be installed. It has always been so easy to run a wire or to put in a battery, or a bell, or a dynamo, which would work for a week, that in very many cases it has not worked any longer. Good work on electrical apparatus often seems so unnecessary that slipshod work is substituted, and it does as well as any other for a while; but suddenly the apparatus fails, and then one hears on all sides complaints of the untrustworthiness of electricity. Nevertheless it is a fact that the naval and military uses of electricity are increasing. The same reasons that have filled modern cities with telephones, telegraph, electric motors and electric lights, are filling our modern war-ships and fortresses with them. The same reasons that gradually replaced the club of the savage with the magazine rifle of the modern soldier are operating to replace the simple but clumsy ships and battery of a few years ago with warships of tremendous power but vast complexity. It seems to be a law of nature that we must pay for what we get. If we will have monstrous engines of war, dirigible with precision and rapidity, we must use complex machinery, protest as we may.

There is one very important phase of this question to be considered, and that is, that in this feverish march of progress, one must either keep up or fall behind; and a navy must either keep up or fall behind. This state of affairs becomes more and more acute the further the march of progress proceeds; and the view may be extended even farther, so that we can see that the more complicated ships and weapons become, and the more education and instruction and drill are needed for their efficient handling, the greater advantage will rest with that navy which devotes to them the needed education, instruction and drill; provided always that the increase of power of offense and defense is sufficient. This statement may be put in another way:—In any apparatus which bestows vastly improved powers of offense or defense, mere complexity is not a disadvantage to any navy which devotes sufficient time and labor to mastering the difficulties, because the very fact of its complication gives that navy great advantage over navies which cannot or do not master the difficulties. This indicates the principal advantage of the civilized soldier over the savage. The civilized soldier is no more brave than the savage, and very often is under the greatest disadvantage by reason of lack of acclimation and of knowledge of the country. But the complicated arms and organization of the civilized forces are too much for the brain of the savage, and he is forced to retreat before the complications of civilization.

This argument is not intended to prove that complexity has of itself advantages over simplicity, because simplicity is the perfection of efficiency, as it is of beauty. It merely points out that the part of wisdom of a highly civilized nation is to develop weapons of the highest possible power, and to educate the officers and men to handle them. An hour every day taken from the merely routine work which highly educated officers of middle life are compelled to do, would show us that our profession is not only one of the most glorious in the world, but one of the most interesting, and would give us an opportunity of keeping up with the progress of the times.

In describing broadly the uses of electricity in naval life, many uses, not strictly new, must needs be included. The subject may be divided somewhat as follows:

Electric Lighting.—The electric light is now a sine qua non in modern warships. The principles previously laid down have been proved correct in practice, and the present development is along the lines of an increasing supply of lights and the gradual improvement of the details of wiring and insulation. The number of officers and men acquainted with electrical things has naturally increased, and this has brought about a better functioning of the apparatus used, as a necessary result. Searchlights of automatic feed, controllable from a distant point, have proved practicable; considerable diversity of opinion still exists as to whether they should be high above the water or low down, but the advocates of high positions are gaining ground. No important change has taken place in signal lights.

Electrically Operated Steam Whistles.—These have been recently tried in both warships and merchant ships with promising results. They do not interfere with the ordinary method of sounding the whistles, so that their use seems to confer a distinct advantage with no offsetting disadvantages.

Motors.—The use of electric motors is clearly on the increase,

especially for ventilating, the training of turrets and the hoisting of ammunition. Perhaps the advantages of electric power over steam are more obvious in the matter of ventilation than in any other field, the principal gain being in the fact that the necessity is avoided for the tremendous air ducts which take up so much room in coal bunkers and living spaces, and the substitution of a number of comparatively small ventilators, each placed where it is wanted, instead of the large steam blowers for which room is so hard to find. The military advantage of the small electric ventilator is one that may easily be overlooked; but it is a well known fact that in many ships the steam blowers have had to be placed above the water line and absolutely unprotected; which means that in the early part of an action the blower supplying one or more of the magazines may, and probably will, be put out of operation by a very insignificant cause, making it absolutely impossible for the men to remain in the magazines.

For training guns, the practice of employing motors is becoming limited to turrets, the mechanism being arranged in such a way that hand power can be used in case of accident. As regards the relative advantages of the three principal powers, steam, hydraulic and electrical, a wide diversity of opinion exists. The great desideratum of simplicity resides, of course, with steam, and many regard this feature as of paramount importance. Others, however, while admitting the superior simplicity of steam, and while admitting the enormous value of simplicity, point out the extreme difficulty of securing a "dead beat" motion with steam, even if a worm and screw be included in the mechanism. They also point out what at first sight may not seem an important point, but which may readily become so—the question of heating; insisting that, no matter what mechanism may be employed, it is after all "the man behind the gun" on whom we must rely, and that the man behind the gun and the men in the passing rooms will not work at their best in an unendurable heat.

THE TESTING DEPARTMENT OF THE GENERAL ELECTRIC CO.'S WORKS.—III.

BY THEO. STRAUS.

The record of all tests is placed on what is known as a Testing Record Sheet. On this sheet appears data such that a person, even if he had never seen the machine, could, at a glance, designate the qualities and action of the machine during the time of the test. After the test, the sheets containing only the original data are handed into the office, where they are first rigidly examined by the foreman. If correct, they are then sent to the Calculating Department for inspection and are then finally approved. If approved, the sheets are sent to the engineering department, where they are placed on file, and the machine is sent to the painting department, where it is made ready for shipment. If the test is not satisfactory the machine is re-tested. It is the policy of the company to actually perform all guarantees on the machines before shipment.

Those of special importance have their tests approved by the designing or department engineers, and the results, placed on file, can at any time be seen by the buyers or their authorized agents. Another point is strenuously adhered to during the test, that is, running the machines with the same brushes, brush-holders, fittings, etc., used after being permanently set up.

The tests given to the machines are of all characters, depending upon the guarantees required. No matter what these are, all the machines receive the company's regular commercial test. This test necessarily varies with the different types and classes of machines, but, nevertheless, the general outline is similar. The following is a description of this test, using as an example a compound wound three-phase generator:

(A) Resistances, Heat-Run and Temperatures.—The generator, before starting up for the heat-run, has its various resistances taken by the Resistance Department connected with the building. This department is fitted up with a very sensitive galvanometer connected to a standard Wheatstone bridge, and another galvanometer calibrated as a voltmeter, used in the drop method, together with a standard Weston ammeter. These have been adjusted to such a degree of accuracy, that readings are obtained within about one-half of one per cent. The department is located at the end of the building, remote from any machines or live wires, which would tend to change the standards, which might produce an error in the readings. Any part of the building can be reached, as wires, permanently stretched, run to binding posts on the various columns. The machine to be measured is connected at the nearest column, and its different resistances are taken. After each set of readings, the resistance of the line is measured and deducted, thus obtaining the true value for the resistances of the machine. Readings are always taken before and after the heat-run.

Each generator has the resistance and temperature of the following parts taken: Separate excited fields, series fields, revolving shunt, series adjustable rheostat and armature (per phase) taken. It is run continuously at a 10 per cent. overload until it assumes a permanent condition, and the temperatures have reached their maximum. Temperatures are then taken on all the accessible parts, and while the thermometers are reaching their maximum, the resistances of the various parts, as stated before, are measured. From the readings in resistance, the rise of temperature can be calculated, giving a check on those obtained from the thermometers.

The temperature by the thermometer is lower than that calculated by the rise in resistance, but the two readings are always proportional to each other. Besides this, tables have been computed from the many tests of a type and class of machines, showing the average and maximum rise in temperature of the different parts. These are also referred to, and if any temperatures rise above the maximum value an investigation is begun, and the defect remedied. At frequent intervals during the heat-run readings are taken as follows: Volts, armature; amperes, armature per line; volts, separate excited field; amperes, separate excited field; volts, across the series winding; amperes, in the series winding; speed and temperature of building. Throughout this run the machine is carefully watched and the condition of its parts such as bearings, commutator, collector rings, etc., are noted on the testing record sheet.

(B) Compounding.—Having no load on the armature and with the machine running at the proper speed, the current in the separately excited field is adjusted until the no load voltage is obtained. Readings are then taken on volts, armature; volts, field; amperes, field, and speed. Keeping the separately excited field current constant, with full load on the machine, and at proper speed, the following data are taken: Volts, armature; amperes, armature; volts, field (separate excited); amperes, field (separate excited); volts, series winding; amperes, series winding, and speed.

From the data thus secured the machine is brought up to proper full load voltage by means of the series adjustable rheostat.

All direct current machines are tested similarly, except in compounding. The ampere-turns in this case are regulated by placing a German silver shunt across the terminals of the series winding, allowing only part of the full load current to flow through the winding. Increasing or diminishing the resistance of the shunt, the machine may be compounded for any voltage. After the heat run the insulation of the various parts of the machine is tested, first, by either the galvanometer method, or the voltmeter method, using a 500-volt direct current. Then a high potential alternating current test is given. This is carried out with great care, and the slightest indication of a ground or short circuit condemns the machine, which after being repaired is re-tested.

The General Electric Company's standard for insulation resistance of their machines is one meg-ohm. Anything less than this is not passed. All machines low in insulation resistance are sent to the oven, and, if possible, baked up.

This department is the culmination point of all the material built at these works. Machines of all description are received, and, no matter how various, are sent forth after a severe and complete test, complaints being seldom thereafter received. To facilitate the following up of these machines, as they tend toward completion, test reports each day are sent to the many different departments.

ELECTRICITY FOR THE LEHIGH CANAL.

A special dispatch of September 12, from Hazleton, Pa., says: The Lehigh Coal and Navigation Company is considering the advisability of equipping the canal with electricity, which, it is claimed, will materially reduce the cost of operation. It is learned that at the last meeting of the directors Prof. Haupt, of Philadelphia, submitted figures showing the cost for such equipment. The Professor says that the Lehigh and Schuylkill Canals are well adapted for this system. His suggestions are to use the falls and dams along the canals to generate the power, and locate dynamos at such places. The estimates made by Prof. Haupt were not given out, but it is understood they show that the cost would be considerably less than animal power, which has been used. The directors have the matter now under consideration.

BALDWINSVILLE, N. Y.—The Baldwinsville Heat and Light Company has been formed with a capital stock of $20,000. The directors are: W. F. Morris, J. W. Upson, W. H. Wells, and J. T. Williams, of that place; W. H. Hoffman, of Stiles; B. Smith, of Syracuse, and J. W. Stearns.

THE ELECTRICAL ENGINEER DATA SHEETS.

SOME months ago, The Electrical Engineer began the publication of digested information in the form of Data Sheets, under the editorship of Mr. Albert B. Herrick. We now append a list of the sheets that have appeared up to date. It will be seen that Mr. Herrick, with great ability and excellent judgment, has already brought together a most interesting and valuable mass of data, which, on account of the manner in which it is printed, and the method adopted for its preservation in filing cases, has added materially to the resources of the practicing engineer. A great many branches of the electrical art have been treated, but we may say that the matter already published is but a fraction of that in hand and now being made ready. The scheme adopted proves very flexible, so that it is easy to add new sheets or replace old ones with more recent data, as occasion arises. Engineering pocketbooks are useful, but these Data Sheets have the advantage of coming up to date, and of being ceaselessly added to and expanded.

INDEX TO PUBLISHED DATA SHEETS.

TELEPHONY AND TELEGRAPHY.

BELL TELEPHONE AND WESTERN UNION.

J. Pierpont Morgan said last week that there was no truth in a published story that he was to conduct a fight for the American Bell Telephone Company against the Western Union Telegraph Company. The New York "World" insists that a fight there must be, and as a "practically official verification" of its assertion prints the following with its subjoined comment:

"There is no need of any further contract between the two companies," he said. "The contract of 1879 was made to cover certain valuable patents held by the Western Union Company, but all of these patents—except the Berliner transmitter, which is now a matter of contest—have run out, and there is nothing to hinder the telephone people from using them. The two companies will undoubtedly continue in their separate fields. The telephone company has certainly no facilities for telegraph service."

It is not expected, however, that the Bell people are going to directly antagonize the Western Union by a rival telegraph plant. It is rather by an extension of the field of telephone service. According to semi-official information, the Bell people discovered long ago that a profit could be made by the transmission by telephone and messenger of 25-word messages for 10 cents. Under the proposed system a Mr. Jones, of Wall street, could step into a convenient telephone station and write, out a message for a Mr. Smith, of Harlem. The telephone attendant would call up the station nearest to Mr. Jones' address, whisper the message to the Harlem operator, who would typewrite it and hand it to a messenger boy for delivery—an arrangement that would be much more economical and quicker than the present telegraph service. The system would, of course, apply to out-of-town messages, as the telephone wires have already pierced almost every village and hamlet in the country.

Under the present agreement the Western Union pays the American District Messenger Company two and one-half cents per message, and a similar arrangement by the telephone company would still leave a wide margin for profit.

THE TELEPHOTIC PROBLEM.—A PROPOSED SOLUTION.

BY DR. ERNST HUBER.

THE striking and puzzling problem of sending light vibrations over a wire has been attacked by many great and illustrious coryphees of technical science. This problem must not be confounded with the well-known one of telautography, by which pictures, photographs, handwriting, etc., are transmitted by electro-chemical or other means. The proposed problem is contained in the following questions:

Is it possible to transmit over one wire the images of objects in motion or at rest, from a transmitting station to a receiving station, at which receiving station the exact reproduction of said objects, in motion or at rest, may be seen by an observer? Is it possible to transmit said objects from one to the other station in such a way that, whatsoever changes in the position of said objects take place, these changes be simultaneously transmitted and may, therefore, be directly observed at the receiving station?

The present unusual prominence of this problem recalled certain efforts of mine made some years ago, the result of which, combined with the recent discoveries of Prof. Röntgen, enables me to illustrate the idea in its fundamental principles. I wish to call attention to the fact that this article is merely written to illustrate the general principles without entering into special mechanical or electro-mechanical details. I will try to present in the following lines a short, condensed description of the principles of the "telephote," or light-sender, fulfilling all the conditions of the aforesaid problem.

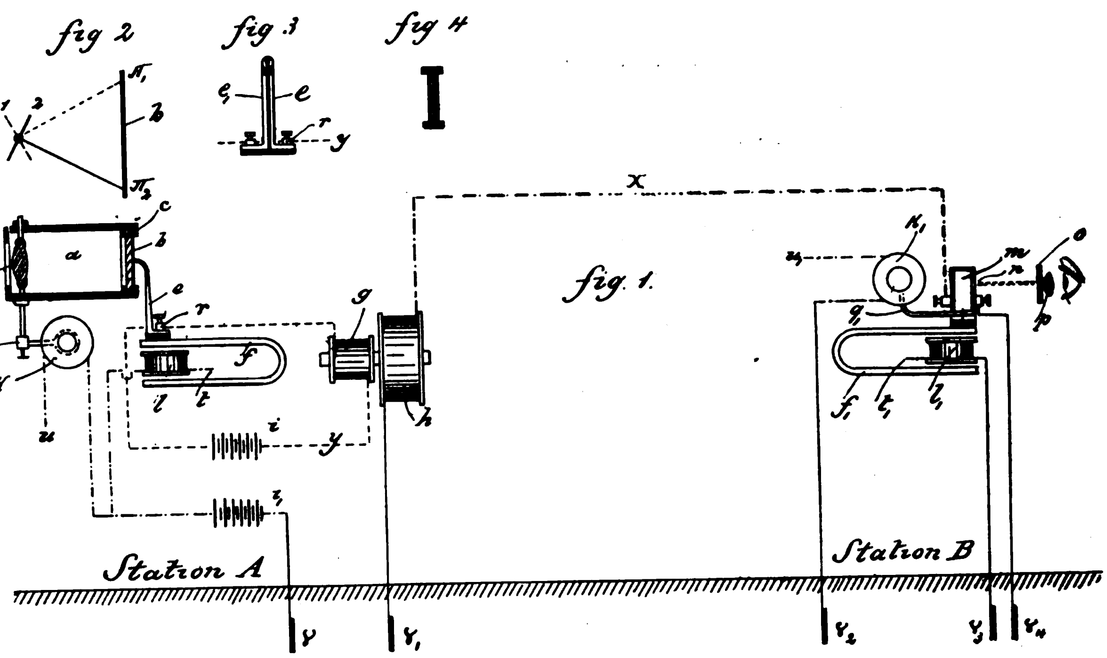
Fig. 1 is a diagram of the apparatus, showing the transmitter at station A and the receiver at station B. Fig. 2 is a diagrammatical section of the photographic lens in its extreme positions. Fig. 3 is a more detailed sketch of the connector. Fig. 4 represents a shaded letter, the picture of which is to be transmitted from station A to station B.

In Fig. 1 a represents a photographic camera provided in front with a lens d and in the rear with a thin film of selenium b, attached to and supported by a glass plate. Crystalline selenium, as is well known, has the very remarkable property of increasing its electric conductivity, when affected by light. According to the intensity of the light thrown upon the metallic film, the conductivity varies, it reaches its maximum at full light and its minimum in darkness. Prof. Bell, in his interesting radiophonic experiments, showed that the differentiation between light and dark is very considerable and that the slightest difference in illumination may be detected by combining a telephone with properly constructed selenium cells. This fact involves a variation of induction in the telephonic receiver and upon this basis the apparatus to be described is constructed.

The lens d is made to oscillate in a horizontal plane, upon a pivot by means of a polarized relay K, so that, as shown in Fig. 2, each half oscillation will carry it to its extreme positions II_1 II_2. F is a tuning fork or vibrator, the vibrations of which are sustained by means of the electro-magnet l, bearing the connector e. This connector is composed of two fine metallic springs e l, Fig. 3, bent at the top and ending there in two needle-like points in close proximity to each other. It is evident that these metallic springs are suitably insulated from each other. Electrical connection with them is established by means of binding posts r r.

The connector e rests with its top upon the selenium film b. Battery i furnishes the necessary current for the main circuit, comprising also the device g h, representing an induction apparatus, of which g is the primary and h the secondary coil. This main circuit of the transmitter runs from battery i to binding post r, spring e, selenium b, spring e, primary coil g, and back to battery. Variations of current intensity in coil g, will produce induction currents in coil h, which are sent over the main line X, to the receiver in station B.

The receiver consists of a tuning fork or vibrator f, operated by an electro-magnet in a way similar to station A. The tuning fork f, supports a Crookes tube m, enveloped with a film of material n, impermeable to X-rays. This envelop is only provided with a very fine aperture through which the rays radiate to a glass screen o, covered with a fluorescing film of barium-platino-cyanide, or calcium tungstate. The Crookes tube is mounted upon the tuning fork so that by means of lever g, it can be oscillated horizontally around its axis by means of relays K. The eye of the observer is placed before a magnifying lens. Reciprocal action between transmitter and receiver is the paramount condition of the proper functioning of the apparatus. The connector e and the Crookes tube m must oscillate synchronously with the same vertical amplitudes, and lens d and tube m must also vibrate synchronously with same horizontal amplitudes. Therefore, the respective relay and electro-magnets are mutually connected so as to establish synchronism and equal elongation.



HUBER'S SYSTEM OF TELEPHOTIC TRANSMISSION.

Suppose an object be placed before the lens d, of the camera, for instance, a letter I, as shown in Fig. 4, be painted on white paper, the picture of which we want to transmit to the receiver at station B. Lens d will project a picture of the letter upon the selenium film. It is necessary to state that this photograph must be of very small dimensions, so that the vibrations of the connector may cover the full height of the picture. It is evident that on this minute projection the black and shaded parts of the letter will affect the conductivity of the selenium. The primary circuit, being closed through the connector over the selenium surface between contact points, resting on said surface, will therefore suffer impacts in infinitely short succession, causing the secondary coil to produce the currents necessary to generate the X-rays.

As the lens d oscillates horizontally, the picture will be carried, on a horizontal line over the plate from II_1 to II_2 and back. The connector, oscillating vertically in extremely short inter-

vals, will, therefore, cover the whole area of the projection. As the Crookes tube vibrates synchronously, horizontally and vertically, and with the same amplitudes as the transmitting apparatus, an image of the same size as the original projection will appear on the fluorescing screen o, which the observer may see by means of the magnifying lens.

In order to elucidate matters I have shaded in Fig. 4 the letter I, so that one-half is entirely dark and the other half in half tone. If the connector vibrates over the dark part, very little or no current is sent over the line to station B, while, when it oscillates on the half-tone, the current will rise to an intensity adequate to the luminosity of that part. As the paper upon which the letter is painted is supposed to be white and well illuminated, it is evident that the surroundings of the letter will contrast strikingly in luminousness, and therefore all the luminous parts will, on the fluorescing screen, also contrast adequately.

As the vibrations of tuning forks and relays may be varied to any number, e. g., 500 to 30,000 per second, it is obvious that within a very small fraction of a second, the area of the reproduced image will be covered on the screen frequently enough to present to the observer a continuous and homogeneous image of the original object, with all the movements which it can possibly undergo. Thus landscapes, horse races, and like events may be seen at distances only limited by the laws of nature. It is evident, that the image produced by the X-rays on the fluorescing screen, may be projected in any suitable manner upon a large surface and thus demonstrated to a large audience.

I feel confident that the practicability and the novelty of execution of the proposed idea will not fail to prove interesting to many readers and being merely actuated by a desire to impart some new and possibly useful information to the scientific world, I conclude by welcoming suggestion and inviting discussion.

REPAIRING TELEPHONE POLES.

The tall poles of the Central New York Telephone and Telegraph Company in this city are being repaired, says the Rome (N. Y.) "Sentinel." Where the poles have decayed at the base the rotten wood is stripped off and heavy plank set in to take its place. The work is neatly done and the joints are carefully fitted so that when the job is completed and the poles repainted, as they will be, a casual observer would hardly notice that they had been patched. The idea of putting a patch on a telegraph pole, as a careful mother would reseat her boy's trousers, strikes almost everybody as a novelty and most people passing a pole where the work happens to be going on have paused involuntarily to watch it and ask questions. Telephone companies are looked upon as bloated monopolies and it seems natural to think that all they have to do when a pole decays is to pull it out and set another in its place, with a lordly disregard for the expense. The companies may have money to sink in the ocean, but they are careful in the management of their business just the same, and economy is at all times their watchword in the matter of expense. The local company is no exception and figures out exactly the cost of maintaining each mile of its line. The expenses of this division, under the supervision of Superintendent Charles N. Crain, are as low as they are anywhere in the territory controlled by the company. The cost of poles is, of course, a considerable item. The timber is pine, and the poles run from 68 to 70 feet in height and cost $25 apiece in the woods. The ones in use in Rome were set five years ago, and where they have decayed it is only on the outer shell where the sap has soaked through. The heart is as sound as it ever was. The patches are made water tight, even the nail holes being carefully puttied up, and when painted protect the wood thoroughly. Under this treatment the life of the poles is extended several years.

THE AMERICAN BELL-WESTERN UNION AGREEMENT.

In an interview in Boston, Director and Attorney Gardiner G. Hubbard, of the American Bell Telephone Company, expresses his opinion that the agreement between his company and the Western Union people will not be renewed when the existing contract expires. Mr. Hubbard says:

"We were a weak company when that agreement was formed, and the Western Union a strong one. We were gainers at first, although we have had to pay a royalty of about $400,000 or $500,000 a year for it. We will not pay a royalty in future. We needed protection, which the contract afforded then. The Western Union people have been gainers by it during the last years, however.

"The agreement has restricted us in our work. It has prevented our delivering messages, which would be considered encroaching on the field of telegraphy. We will be free from that restriction hereafter. It has been especially irksome in our short-distance transactions. What footing we will continue on I cannot say at present. It will probably be a secondary agreement to compete with each other as little as possible."

POSTAL TELEGRAPH'S NEW SOUTHERN LINE.

In consequence of the expiration of Western Union contracts the lines of telegraph on the Chesapeake Ohio and Southwestern Railroad and on the Yazoo and Mississippi Valley Railroad have been taken over, and hereafter will be operated by the Postal Telegraph Company. Both of the railroads named are in the Illinois Central system. The Western Union contracts expired on the 6th inst., and control of the lines was at once given to the Postal Company. Second Vice-President Bradley of that company states that this change will give the Postal Company a through line from Louisville to Memphis. The Chesapeake, Ohio and Southwestern telegraph lines include 1,500 miles of wire, with about fifty offices.

SUBMARINE CABLES IN WAR TIME.

Mr. James A. Scrymser, in a letter to the papers, says: "I enclose for your information an extract from a speech made by Commodore Suenson, general manager of the Northern Telegraph Company, connecting Japan and China, in London on August 14:

"'Allow me to add one more fact and one more reflection to this hurried sketch of the history of telegraphy in China. The fact is this, that although China since 1884 has been engaged in two wars with foreign powers, neither the Chinese government nor the French in 1884 and 1885, nor the Japanese in 1894 and 1895, have interfered with the telegraph cables landed on Chinese territory or with the service performed by them. They have been allowed to pursue their neutral, useful, and peaceful work to the benefit of all parties concerned, although in the last war they directly connected the two belligerent powers. This is a proof of regard for neutral property, of respect for international telegraphy, and of recognition of the immense services rendered by it, which ought to be noted, and to serve not only as an example worthy of imitation, but also as an argument in favor of the submarine companies' repeated demands for the neutrality and the inviolability of neutral cables in time of war.'

"It is to be hoped that Commodore Suenson's eloquent appeal to belligerents to respect the property of submarine cable companies will not, now that such a good example has been set us in the Far East, fall on deaf ears, but that a decision creditable to Western civilization will be arrived at."

THE CANADIAN PACIFIC CABLE.

A special dispatch from London of Sept. 12 says: The Colonial Office, responding to an inquiry as to the truth of a report in American newspapers that the Pacific Cable Commission has decided forthwith to lay the Vancouver-Australian cable, says that the report is incorrect. The Cable Commission has only affirmed the general principles of the desirability of an all British cable to Australia, and will not deliberate further on the subject until the views of Mr. Laurier, the Canadian Prime Minister, are known.

ENGLISH POSTAL TELEGRAPH FIGURES.

For the last five years the English government telegraphs have shown a deficit. This year it is less than usual and reached $175,000. There was an increase of 10 per cent. in the telegrams, the number sent being 78,839,600; of these nearly 6,000,000 were sent at press rates. The telephone system has been open to the public under post office charge since July, 1895, but no figures as to its use are given. Of the post offices 11,000 are money order and savings bank offices and 7,653 telegraph offices, but telegrams can be sent in addition from 2,273 offices at railroad stations. The year has been the most prosperous in the history of the post office, and in the history of England, but still the telegraphs did not pay.

DOG AND TELEGRAPH.

The most intelligent dog I know "resides" at Haxey, in the Isle of Axholme, and is named Staffa. Some years since, when his owner was appointed Sub-Postmaster of the village, Staffa learned to distinguish the telegraph call signal of the office in less than three weeks. I was present in the office one day, and was asking the telegraph clerk how she got on with her work, when the needle began to sound. Almost immediately Staffa came trotting in with the messenger's hat in his mouth. "Why," said the girl, "that must be our call;" and so it was.

The dog had known it before the clerk. To appreciate this fact it should be known that the call signals of two or three of the offices on the circuit are so much alike in sound that even a practiced ear may be in doubt as to which is which. Staffa, however, I was assured, never made a mistake.—"Notes and Queries."

SOCIETY AND CLUB NOTES.

INTERNATIONAL ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS.

UNDER the above somewhat copious title, the fire and police superintendents of the country have formed an organization. A meeting called on the initiative of Mr. F. C. Mason was held in Brooklyn last week, that gentleman being superintendent of the local police telegraphs; and several officials were present while others signified by letter or telegram their desire to co-operate.

W. L. Ellett, of Elmira, as chairman of the temporary Executive Committee, reported on the constitution and by-laws. They were adopted as read. The main features of the constitution and by-laws as adopted were:

"The name of the association shall be the International Association of Fire and Police Telegraph Superintendents, and its office shall be at the place where the secretary resides.

"The object of this association shall be the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of fire and police telegraphic systems, and diffusion of this knowledge among the members of this association, with the view of improving the service and reducing its cost; and the establishment and maintenance of a spirit of fraternity among the members of the association.

"The active members of this association shall consist of superintendents of fire and police telegraphic systems of the municipalities and towns of America, and other persons having charge of municipal telegraph systems.

"The association members shall consist of all others connected with said police and fire telegraph systems, and those connected with appliances relating to such systems. Associate members shall not be entitled to vote.

"The officers shall consist of a president, vice-president and five others, who shall constitute the Executive Committee; also, a secretary and treasurer.

The meeting next proceeded to the election of permanent officers. Mr. Mason was proposed as president, but he said that in view of the fact that his motives in forming the association had been questioned, he thought it were best for the interests of the association if some other gentleman was chosen, and he respectfully declined the nomination.

On motion of Mr. Smith the nominations were closed, and the secretary cast one vote, electing Mr. Mason president.

In taking the chair Mr. Mason said while he had wished some one else had been chosen, still as the association had insisted on his election, he appreciated the high honor conferred on him and considered the present as one of the happiest moments of his life, and he thanked the organization for its kindness.

Morris W. Mead, of Pittsburg, Pa., was elected vice-president; L. Lemon, of Baltimore, Md., secretary, and Adam Bosch, of Newark, treasurer.

The following were elected as permanent Executive Committee: John P. Barrett, Chicago, chairman; William C. Smith, New Haven; S. L. Wheeler, Springfield; J. F. Zeluff, Paterson, and W. Y. Ellett, Elmira.

On motion it was decided to make charter members of all those not present who had sent in their applications. It was decided that when adjourning the association should adjourn subject to the call of the Executive Commitee and that the Executive Committee should designate the city in which the next annual meeting should be held.

As an amendment to the constitution, Mr. Ellett proposed that honorary members be elected at each annual session, who should, while the session lasted, have all the privileges of membership except that of voting.

A vote of thanks was extended to Mr. Mason for his good work, and to the press for its reports of the association. The meeting then adjourned for a year.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The Institute will open its season of 1896-7 by an inaugural address from Dr. Louis Duncan, president, on the "Present Status of Power Transmission," on Wednesday, Sept. 23, at 8 p. m., at 12 West Thirty-first street.

PERSONAL.

PROFESSOR HENRI MOISSAN.

WE are glad to be able to publish this week the portrait of Prof. Henri Moissan, and to welcome the distinguished French chemist to American shores, where he is already so well known, especially among electricians, for his work with the electric furnace. He comes to represent the University of France at the celebrations at Princeton College. Prof. Moissan was born in Paris in 1852. He studied at the Faculty of Sciences and the Natural History Museum, passed an examination as a first-class pharmacist, and in 1879 became professor of practical chemistry at the Paris Superior School of Pharmacy. In 1886 he was appointed to the chair of toxicology, which he still holds. He graduated as Doctor of Sciences in 1880, and has been a member of the Academy of Medicine since 1888. The Lacaze prize was awarded to him in 1887 by the Academy of Sciences, which also in 1891 conferred on him the honor of membership. This year Prof. Moissan was one of the representatives from France at the Kelvin Jubilee at Glasgow University, and one of the recipients of the degrees conferred in honor of the occasion.

PROFESSOR HENRI MOISSAN.

In December, 1892, Prof. Moissan brought to the notice of the French Academy of Sciences his improved electrical furnace, giving a heat up to 3,000° Cent. and melting numerous oxides before regarded as irreducible. In 1893, his production of actual "diamond dust" in his furnace created a great sensation everywhere; and that work has since been followed up in various ways.

Prof. Moissan is, with the exception of M. Picard, the youngest member of the Academy of Sciences. He has a very agreeable personality, and has become widely known not only by his work but by his writings. He speaks English very well and has many acquaintances among Americans. He is accompanied on the present trip by his wife and young son.

MR. ALBERT SCHMID, the well known electrical engineer, has just returned to this country after a vacation of several months in Europe. He devoted a good deal of leisure to a careful inspection of electrical and engineering work on the other side of the Atlantic.

MARRIED.

Mr. Carlton N. Sadler, superintendent of the Orient Electric Co., of Youngstown, O., was married recently to Miss Maude Acheson, daughter of Dr. and Mrs. N. B. Acheson, of Youngstown, O

OBITUARY.

IN MEMORIAM—CHARLES E. BLIVEN.

BY W. J. JENKS.

Please permit one who knew him well to briefly record a tribute of respect to the memory of Charles E. Bliven, of Chicago, who died in Philadelphia, August 29, aged 61.

Major. Bliven was one of the old-timers in telegraph work. His army experiences with electrical apparatus contributed much to the general knowledge of electrical phenomena which enabled him in recent years to appreciate readily and clearly the proper relations between the insurance fraternity with which he was identified, and the engineers who were developing the electric light and power industry.

In 1890 he was sent, while Secretary of the Western Union Fire Underwriters' Association, to attend that important convention at Cape May, where the two interests first joined hands, through their executive officials and duly authorized representatives, for the creation of a code of electrical rules capable of ready adaptation to the necessities of the country at large. The convention was in session for two days in advance of the regular meetings of the National Electric Light Association. Major Bliven's natural leadership was at once recognized and he was made presiding officer of the council (which organized as the National Electro-Insurance Bureau), and also chairman of a codifying committee chosen by the bureau, by which committee all the then existing codes of rules were gathered and laboriously digested. The result of that patient work was the promulgation of "The National Code," which was first reported by Major Bliven to the Western Union Association at its meeting of August, 1891, at Niagara Falls, and at his recommendation adopted as the fundamental insurance law in some sixteen States. Later the code was also adopted by the National Electric Light Association; then by others, until for the past two or three years it has formed the basis of all the modifications which have been made in different States or districts of the country, to conform to local conditions. This result was apparent after two years' experience in the use of the new rules, during which time the work of the bureau was supplemented by the Underwriters' International Electric Association, of which Major Bliven was at its organization made president. His appreciation of this result appears by the following letter:

"W. J. Jenks, Esq., 44 Broad St., New York.

"Dear Sir:—With you, I have been thinking for some time past that there should be a meeting of the bureau, but I do not see my way clear to call a meeting, the members being so widely separated. I will correspond with the committee and advise you further.

"The national code of rules which was prepared by the bureau, have with very slight changes made by the International Association, been put in force in nearly all parts of the country. Yours very truly, C. E. BLIVEN, President."

It may safely be said that no more important step than the general adoption of this code was ever taken in practical demonstration of the harmony of the insurance and electrical interests, which have often been represented as radically opposed. The best methods of enforcement of the code occupied much of the thought of Major Bliven up to the time of his mental failure from overwork.

He presided at the World's Fire Insurance Congress at Chicago, in 1893, and worthily represented there the intermediate position, with reference to insurance and electrical interests, which is still occupied by Captain William Brophy, of Boston, and a few younger men, of whom F. E. Cabot and W. H. Merrill, Jr., are well known representatives.

Major Bliven's death comes as a personal loss to every reader of The Electrical Engineer, who had the good fortune to know him. Broad-minded in the best sense, conservative, tactful, well-balanced, quiet, but forcible, in all his utterances, genial and sympathetic in every relation of life, he commanded instant attention whenever he spoke by word or pen, and the respect of all who listened or read.

Mr. Bliven was born in Phelps, N. Y., Sept. 21, 1835, and when but six years of age his parents removed to Toledo, O. After having attended the public schools he entered the Ohio Wesleyan University and later the Cincinnati Law School. During much of this time he was in the telegraph service out of school hours, first as messenger and then as operator, until he finally became superintendent of the railway telegraph department of what was then the Michigan Southern and Northern Indiana Railroad. During the war he built several military telegraph lines for the Union Army, and when he retired from the service in 1866, it was with the rank of major. He was admitted about this time to the Ohio bar and practiced law for a few years.

He entered the insurance business about the time of the formation of the Fire Underwriters' Association of the Northwest, of which he was the first secretary, serving until 1876, when he was elected president. His first business connection was with the Western of Buffalo, N. Y., of which he was local and special agent. He was general agent of the Howard, N. Y., for fourteen years, and became general manager of the Western department of the American of Philadelphia in 1885.

In social life Major. Bliven was everywhere popular, and he was an active and prominent member of many of the Masonic orders, and also of the Loyal Legion, as well as of the G. A. R.

CHARLES L. CHAPIN.

Charles L. Chapin, one of the oldest telegraphers in the country, died last week in Philadelphia, at the age of sixty-six, after fifty years of continuous service in his calling. He began work as a telegrapher when sixteen years old, being selected in 1846 as operator at the Coney Island end of the second line put up between the island and Brooklyn for the maritime service. Two years before that S. F. B. Morse, who was an intimate friend of his father, Loring D. Chapin, presented to him a copy of the Morse alphabet and told him to learn it as it might some time be useful to him. In less than a year after he began work he and his associate on the Coney Island wire, Charles Robinson, were sent by the Moehrings of this city to Europe to introduce the maritime telegraph idea there. They instituted successfully a line between Hamburg and Cuxhaven, and were called then to Russia by the Czar to build a line connecting the imperial residence at St. Petersburg and the summer palace. In 1850, when Ezra Cornell established the telegraph line through this State, connecting New York with Erie, Chapin was engaged as an operator, and two years later he became superintendent of the eastern division of the New York and Erie Railroad telegraph, and from the work he accomplished there he came to be called the father of the system of running trains by means of the telegraph. He instituted the method experimentally to clear a blockade of freight trains which clogged all the switches of the single track road during a protracted snow storm. In 1854 he took charge of the police telegraph service in New York, and held the place during the police riots of Fernando Wood's troublous times and throughout the period of the draft riots. Later he became superintendent of the fire alarm telegraph, but he didn't quite suit Tweed, and in 1870 he was dismissed. From 1879 to 1887 Mr. Chapin was superintendent of the American District Telegraph in New York, and went then to Philadelphia to take charge of the telegraph and telephone system of the Bureau of Gas, continuing in that place until his death. His association with Morse he was proud of, and he treasured a letter of recommendation, dated 1853, in which the inventor commended him for any post in which a knowledge of the Morse instruments and system was required, and as his father's friend and his own wished him all success.

EDUCATIONAL.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

The prospectus for 1896-7, just issued by the Institute gives promise of a very busy and instructive season. The Department in Electricity has made arangements for lectures by Messrs J. L. Woodbridge, S. Sheldon, W. M. Hutchinson, E. J. Houston, W. C. Peckham, C. E. Emery, W. S. Barstow and G. S. Dunn. A special course of five lectures will be given by Dr. M. I. Pupin. Lectures of interest to electricians will also be given in the Departments of Engineering and Physics.

MR. J. C. GALLUP, secretary of the Correspondence School of Technology, Cleveland, writes us that the school is still growing in reputation and is gaining many students from every rank of those engaged in technical work. Courses are arranged both for beginners and for those desiring advanced study. The time taken to complete the course varies from one year for the elementary to four years for the advanced work. A system of monthly payments has been instituted for the benefit of those who find it more convenient to meet the dues in that manner.

LETTERS TO THE EDITOR.

A DEFENCE OF THE THOMSON RECORDING WATTMETER.

I THINK it not unlikely that very many of your readers may have perused with more or less interest the paper on Recording Meters, which was read by Mr. James Milne, on the occasion of the Sixth Convention of the Canadian Electrical Association, at Toronto. I have myself read this paper with much interest, and I particularly appreciate and concur in the justice which Mr. Milne has meted out to the old and reliable Edison Chemical Meter. I cannot, however, but take exception to many of the statements which he makes in referring to certain of the mechanical meters, more particularly to the Thomson recording wattmeter.

Referring to this instrument, Mr. Milne expresses some doubt as to whether it is any advantage to an illuminating company to have in service on its mains a meter which is adapted for either continuous or alternating current of any frequency without recalibration. I believe that a careful canvassing of the stations in the United States would show that this is in reality a marked advantage to almost every meter user. There is, indeed, a very large number of stations in America to-day which are distributing light both by the direct and alternating system, and generally at the same potential. To such companies the advantage of a meter which can be used indiscriminately on either system is obvious.

Not a few of these stations also supply current from their alternating mains and from their direct current mains at different periods of the day to the same users and through the same meter. This is apparently a practice which is growing in popularity, although, of course, only applicable when no motors are in use.

Again, very commonly illuminating companies which are operating both systems not uncommonly have some outlying districts which they are to-day operating, by reason of their distance from the center of distribution, by means of alternating mains and substation transformers, but which they eventually contemplate changing over to the direct current system so soon as the local business warrants so doing. In such cases as this there is surely a marked advantage in being able to make the change without the recalibration or alteration of the meter in any particular.

Not a few stations also have during the past two years found it advantageous to change the frequency of their system, and to such stations as these the ability to use the Thomson recording wattmeters, which they already had installed, without recalibrating them for the changed frequency, has been an advantage far more real than imaginary. In doubting the advantage of the universal character of the meter, therefore, the paper has, I think, run counter to the general experience of meter users.

Referring to the accuracy of the Thomson recording wattmeter upon light loads, I notice that in the paper it is associated indiscriminately with a very large class of mechanical meters, which are represented as failing to give accurate results on the light load readings. An example is cited of a 500 light meter which fails to start below five lights, and Mr. Milne complains that at this load it takes very good eyesight to note its rotation.

Without commenting on the fact that 1 per cent. of the meter's rated capacity is surely as low as anyone could expect it to record, I would call attention to the fact that the proper speed of rotation for a meter of this capacity, if absolutely accurate, would be only about one revolution in 720 seconds with a sixty watt lamp. It is not to be wondered at, therefore, that the operation of the meter should seem slow to the casual observer, even though it were recording with absolute accuracy. This very feature of the meter is undoubtedly a great merit—namely—the fact that the meter is essentially a piece of low speed apparatus, and to most of us this means without question long life; a fact that is borne out well by the behavior of the meter.

Although I do not care to enter into a discussion of the relative accuracy of the various meters upon the market, I think it can do no harm to point out that compared with results obtained by the larger illuminating companies it is quite certain that the accuracy obtainable with the Thomson recording wattmeter in commercial practice far exceeds that obtainable with the old and always reliable chemical meter, which is so ably advocated, and no where in the load curve is the relative accuracy of the two instruments so conspicuous as at the lighter loads.

This paper goes on to state, that in actual practice after a period of use it would take twelve lamps to make a 500 light meter of the Thomson recording wattmeter type record at all, and that therefore, the current to at least eight to ten lamps has no registering effects upon the meter whatever; and upon this assumption are built up some very dreadful figures, assuming that the meter will run on this light load for 3½ hours every night for five nights in the week, and coming out at the end of the figures with a net loss, which, by an unfortunate mistake of the printer is shown as 4½ per cent., but which, upon checking these figures over, we are sure must have been intended to read 3 per cent., as it figures that way.

I agree in thinking that the case cited appears to have been an aggravated case. Commonly users of any meter whatsoever, under conditions such as those described, would have taken means to prevent the running of a small number of lights for a considerable period regularly upon a very large meter. Ordinarily, I believe we reach such difficulties as this by installing the hall and office lights of theatres, etc., on a separate small capacity meter.

It is further stated, in this paper, that this same percentage of error holds good on the smaller meters. I frankly agree that the percentage of accuracy in the larger meters is as good as the percentage of accuracy in the smaller ones at the same percentage of total load, but I do not think that this brings the matter out in a new and serious light by any means; for, if a 500-light meter fails to run on 10 lights, then a 100-light meter would fail to run on two lights, and whilst it is not my experience that the average 100-light meter will behave in this manner, I nevertheless believe I am voicing the opinion of most central station men when I say that a 100 light meter is seldom, if ever, installed at a point where a load as small as two lights would be placed upon it. I am forced to believe from the strong manner in which this particular characteristic of meters is brought out, and applied more particularly to the Thomson recording wattmeter, that other standard meters have not been carefully investigated with a view to obtaining data in regard to their behavior under similar conditions.

Referring to yet another factor in central station meter operation, I quote the following: "I think I am pretty safe in stating that the motor meter has nearly outlived its usefulness as far as elevator work is concerned." This statement is based on the assumption that the recording meter in question reminds one "of a lazy man, slow to start and quick to stop."

While very reluctant to take issue on this or any other matter, I believe that I am pretty safe in stating that the one thing which the Thomson recording wattmeter will do a little better and more accurately than anything else in the way of difficult measuring, is to render a true account of the energy consumed by electric elevators. It is a fact well known to engineers that there is no more efficient means of storing power than by conserving it in a rotating disc or flywheel. In the Thomson recording wattmeter every watt of the energy which passes through its coils plays its definite part in spinning up the shaft mechanism of the meter to a definite speed, representative of the energy applied; and from the very theory of the meter it should be obvious that the reluctance of the mechanism to start forward is almost exactly offset by the continuance of rotation after the cessation of applied energy. Since, however, experiments are commonly more convincing than theory, it may do no harm to state that I have been concerned in certain experiments to determine this particular factor in connection with the meter's behavior; and these experiments were made at a time when the meter had not reached its present perfection.

They consisted in installing two meters in multiple and in series with a third meter of the same capacity as themselves. These meters were then so arranged (with a special switch) that a constant amount of energy passed through the single meter without interruption, this same energy passing through the two meters which were in multiple, sometimes half through each, sometimes all through one and sometimes all through the other, the changes in all cases being abrupt. One could scarcely conceive of a more intermittent use of current than this arrangement gave, yet the sum of the record of the two meters which measured current alternately or in multiple, agreed within less than two per cent. with the indication of the third meter through which the current flowed in constant quantity and without interruption.

Trusting that I may be pardoned for using so much of your valuable space, and offering as my excuse the fact that I am one of those who take a keen interest in the meter problem and who is not quite unfamiliar with the subject, I am, etc.,

CARYL D. HASKINS.

Boston, Sept. 4, 1896.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Dynamos and Motors:

GRAPHIC REPRESENTATION OF THE FLUX IN THE ENTREFER (AIR GAP) OF DYNAMOS.—By M. Aliamet. The value is determined by a series of measurements taken on a given scale and traced in polar co-ordinates. The method is due to M. A. Merrill.—From "L'Electricien," in Lond. "Elec. Rev.," Aug. 21, '96.

A NON-SYNCHRONOUS TWO-PHASE ALTERNATE CURRENT MOTOR.—By Ernest Wilson. An investigation of currents in armature conductors, and their effects upon the magnetic field of the motor. A detailed description of the design with many tables and curves of experimental results. The design is somewhat different from the ordinary alternating current motor in vogue.—Lond. "Elec.," Aug. 28, '96.

Electro-Chemistry:

MANUFACTURE OF CHEMICALS BY NIAGARA POWER.—By Orrin E. Dunlap. Description of the plant of the Chemical Construction Company, which has a lease for 4,000 h. p. to manufacture chlorate of potash, chlorate of soda, chlorate of barium, etc. "Elec. Eng'r." Sept. 9, '96.

ELECTROLYTIC MAGNESIUM AND ANTIMONY.—By F. Oettel. An apparatus for preparing magnesium on a small scale in the laboratory. Also commercial electro-deposited antimony described.—"Zeitschr. f. Electrochem.," 2 p. 424, p. 525; also Lond. "Elec. Rev.," Aug. 21, '96.

Lighting:

TEST OF A 300 H. P. DE LAVAL STEAM TURBINE IN THE 12TH ST., N. Y., EDISON STATION.—Three tables giving operating data of a six-hour test under conditions of full load, some tests under partial load when operated with 2, 4, 6, and 7 steam jets and temperature readings. "Elec. Eng'r." Sept. 9, '96. "Electricity." Sept. 9, '96.

ACCUMULATOR ACCESSORIES.—A dynamo with two commutators designed for small isolated plants where storage batteries are to be charged with a raised voltage. Lond. "Electricity." Aug. 14, '96.

Magnetism:

TERRESTRIAL MAGNETIC QUANTITIES.—By L. A. Bauer. Discussion on notation. "Science." Aug. 28, '96.

APPARATUS FOR TESTING MAGNETIC PERMEABILITY AND HYSTERESIS OF IRON.—Shown by Prof. Ayrton and Mr. Mather at the Royal Soc., June 10, '96. It consists of a small separately excited dynamo with a very short air space whilst the test piece forms the yoke between two massive pole pieces and is comparatively long. The whole set occupies a floor space of 22 inches by 12 inches and is 4½ inches high.—Lond. "Elec.," Aug. 28, '96.

Measurements:

TESTING DEPARTMENT OF GENERAL ELECTRIC COMPANY'S WORKS.—By Theo. Straus. The first of a series of articles deals with the testing building and the wiring in the same. "Elec. Eng'r." Sept. 9, '96.

LIGHTNING ARRESTERS.—By Wm. Baxter, Jr. After a brief statement of the actions of, and requirements for, a proper lightning arrester, author gives an illustrated description of an arrester which he designed some years ago. "Elec. Eng'r." Sept. 9, '96.

Mining:

VIRGINIUS MINES.—This power is derived from the water of the Red Canyon Creek, which is brought through a pipe line 4,000 feet long to Pelton wheels which drive G. E. bipolar dynamos. The transmission line passes first through dense timber, then over rocks and chasms and heavy snow drifts until it reaches the mine four miles away from the power house. The current is direct and the voltage 800 volts. The motors drive hoists, pumps, blowers, stamping mills, drills, and an order has recently been given for an 800-volt two-motor mining locomotive for hauling the silver-ore laden wagons in the mine. The daily expense for coal before the use of the electric plant was over $100—a ton of coal costing about $18. "Colliery Eng'r and Metal Miner." Aug., '96.

Power Transmission:

ELECTRIC TRANSMISSION FROM TIVOLI TO ROME.—Abstract of this 2,000 horse-power, 28 kilowatt transmission plant, taken from the catalogue of Ganz & Co.—"Elektrotechn. Anzeiger," Aug. 29, '96.

Railways:

LONG DISTANCE AND HEAVY DUTY ELECTRIC RAILWAYS.—By F. W. Darlington. Paper read at Altoona, Pa., before the Penn. Street Railway Assoc., Sept. 2, '96. Author dwells principally on the advantages of Electric over Steam roads. "Elec. Eng'r." Sept. 9, '96.

STREET RAILWAY CONVENTION OF N. Y. STATE.—A complete list of the papers presented.—"Elec. Age," Aug. 29, '96.

Roentgen Rays:

PRACTICABILITY OF THE STATIC MACHINE FOR X-RAY WORK.—A new type of Topler-Holtz machine is illustrated and described. "Elec. Eng'r." Sept. 9, '96.

APPLICATION OF ROENTGEN RAYS.—A few excellent pictures apparently reproduced from Dr. Morton's forthcoming book on the subject.—"Elec. Age," Aug. 29, '96.

A NEW TUBE.—By M. Kundson. A tube with a very heavy cathode which tends to dissipate the heat generated.—"Chemiker Zeit.," Aug. 22, '96.

Telephony, Telegraphy, etc:

CABLE LAYING ON THE AMAZON RIVER.—By Alexander Siemens. Abstract of paper read before the Royal Soc. of Great Britain. Conditions and incidents during the progress of the work. "Elec. Doings." Sept., '96.

Wiring:

MANUFACTURE OF WIRE.—By F. A. C. Perrine, D. Sc. Author treats galvanization, stranding of copper wires, gauging, wire gauges. "Elec. Eng'ing." Sept., '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 8, 1896.

Alarms and Signals:—

PROTECTIVE SYSTEM FOR BUILDINGS. C. Burgher, Newton, Mass., 567,577. Filed Nov. 23, 1895.
Details of construction.

RAILWAY CROSSING SIGNAL. C. Selden, Baltimore, Md., 567,753. Filed April 21, 1896.
Details of construction.

ELECTRIC SIGNAL. C. P. Wilkinson, Jackson, Mich., 567,759. Filed Dec. 7, 1895.
A lever having a head at the lower end set at an oblique angle edgewise to the wire and trolley wheel, so that the wheel will have a shearing contact with the head.

ELECTRIC TRACK SIGNAL. C. P. Wilkinson, Jackson, Mich., 567,760. Filed Dec. 12, 1895.
Similar to above.

BURGLAR ALARM. W. H. Ward, Mound City, Kan., 567,845. Filed June 23, 1896.
A contact is made by means of a movable floor arranged above the vault floor.

Batteries:—

MOLD FOR BATTERY PLATES. C. G. Fawkes, Denver, Colo., 567,705. Filed Aug. 7, 1895.
Leaves constructed with counter-sunk portions on the inner faces, and provided with separated lugs arranged in line to form openings in the sides of the battery plates, combined with a removable core, the parts of which are slotted so as to allow the separated lugs on the two leaves to meet through the slot.

METHOD OF PRODUCING ELECTRICITY. J. R. Payson, Jr., Chicago, Ill., 567,721. Filed Feb. 24, 1896.
The electrolyte surrounding the positive electrode contains sulphuretted hydrogen and ammonia; air is supplied to the negative electrode.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. G. E. Dorman, Chicago, Ill., 567,586. Filed Feb. 4, 1896.
Comprises a base provided with an upwardly projecting pole-piece, a second pole-piece opposite first pole-piece and consisting of two or more independent sections, independently connected with the lower portion.

AUTOMATIC REGULATOR FOR ELECTRIC MOTORS. H. P. Merriam, New York, 567,651. Filed April 28, 1896.
Comprises a variable resistance, a switch and means of cutting out the resistance operated by an increase of pressure in the operated mechanism.

DYNAMO ELECTRIC MACHINE. H. W. Libbey, Boston, Mass., 567,719. Filed Sept. 16, 1895.

Particularly adapted for generating electricity for headlights for bicycles.

COMMUTATOR. F. J. Haerer and C. L. Gikeleiter, Philadelphia, Pa., 567,745. Filed April 11, 1896.

Comprises a plurality of half discs, having recesses near their periphery, means for holding said discs in assembled position and filling piece for recesses.

ARMATURE FOR DYNAMO ELECTRIC MACHINES. F. J. Haerer and C. L. Gikeleiter, Philadelphia, Pa., 567,746. Filed April 11, 1896.

Comprises a plurality of coils or windings which are supported upon heads, clamps mounted upon heads and adapted to lock the coils in position and means for securing the clamps to the heads.

Electro-Metallurgy:—

PROCESS OF TINNING OR GALVANIZING METALS. A. S. Ramage, Cleveland, O., 567,612. Filed Nov. 4, 1895.

Consists in subjecting iron plates to a bath containing salts of iron and sodium or ammonium salts making the iron the anode in the process of electrolysis whereby the scale is removed and the pure iron contained therein deposited upon the cathode, then reversing the polarity of the electrodes and re-depositing the pure iron.

ELECTRIC SMELTING FURNACE. J. A. Vincent, Philadelphia, Pa., 567,699. Filed Oct. 30, 1895.

In combination a vertical hearth, lateral acting electrodes and a movable bottom which recedes as the melted product increases within the hearth.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. P. R. Salberg, Allegheny, Pa., 567,691. Filed Jan. 11, 1896.

Feed mechanism.

ELECTRIC ARC LAMP. J. McLaughlin, Chicago, Ill., 567,840. Filed March 4, 1895.

Details of construction.

Miscellaneous:—

ELECTROMAGNET PIN-EXTRACTOR ATTACHMENT FOR CLOTH FINISHING MACHINES. A. C. Shuttleworth, Philadelphia, Pa., 567,619. Filed Nov. 12, 1895.

The combination of a supporting framework, and an electromagnet having extending poles relatively associated and constructed to overlap each other.

PROCESS OF PRODUCING AND COATING PATTERNS. W. P. Smith, Albany, N. Y., 567,694. Filed April 28, 1896.

Consists in coating a non-conducting substance, such as hard rubber by depositing metallic nickel upon the surface.

DIAPHRAGM CLAMP FOR PHONOGRAPHS. V. H. Emerson, Newark, N. J., 567,738. Filed Dec. 20, 1895.

ELECTRICAL CONDENSER. N. Tesla, New York, 567,818. Filed June 17, 1896.

Provided with means for the exclusion of air and gas, and an armature composed of a conducting liquid.

CONTACT DEVICE. F. W. N. E. Hayn, Bahia, Brazil, 567,899. Filed May 14, 1896.

Embodies an aluminum contact bar.

INTERCHANGEABLE ELECTRIC SIGN. W. J. Scott and H. W. Shonnard, New York, 567,924. Filed May 22, 1896.

Consists in the construction of a reservoir for holding the letters and delivering them to and receiving them from the visual sign board.

IGNITING DEVICE. H. Van Hoevenbergh, New York, 567,928. Filed July 1, 1896.

Comprises a plurality of fine conductors supported in contact with one another at a number of points.

Railways and Appliances:—

STREET ANNUNCIATOR. H. P. Frear, San Francisco, Cal., 567,643. Filed Nov. 13, 1895.

Consists of a revolvable drum provided with a series of hinged tablets, a chamber within the drum's contour containing an electromagnet, armature and pawl, by means of which the drum is revolved.

ELECTRIC LOCOMOTIVE. S. H. Short, Cleveland, O., 567,662. Filed Sept. 3, 1895.

Embodies a vertically swinging frame in which the motor is mounted.

TROLLEY CATCHER. O. R. Sackett, Niagara Falls, N. Y., 567,690. Filed May 16, 1896.

A supporting frame pivoted at its upper end to the trolley pole so as to be capable of reversal thereon, a spring drum journaled in frame, and a rope or cord wound upon the drum.

TROLLEY CONTACT DEVICE. R. Skeen, Madison, Ill., 567,754. Filed Sept. 19, 1895.

Comprises a supporting bar adapted to be insulatingly mounted above the trolley wire and having depending plate fingers adapted to contact with the trolley groove as the trolley passes along the adjacent wire.

INSULATED CROSSOVER FOR TROLLEY WIRES. A. Hanson, Chicago, Ill., 567,784. Filed April 3, 1896.

Details of construction.

ELECTRIC CONTACT DEVICE. R. Skeen, Madison, Ill., 567,816. Filed Feb. 17, 1896.

Comprises a laterally movable piece insulatingly mounted above the trolley wire, its lower edge lying in the path of the trolley, a guard strip along one side of the lower edge of said piece, and insulating material between the guard strip and the piece.

BOND FOR ELECTRIC RAILWAYS. J. McLaughlin, Chicago, Ill., 567,841. Filed April 13, 1896.

Consists of a conductor, a bushing and a self-locking key.

TROLLEY GUARD. F. S. Birth, Philadelphia, Pa., 567,879. Filed Nov. 19, 1895.

Comprises a primary trolley wheel, a rock arm pivoted to the trolley arm, two secondary trolley wheels journaled in the rock arm and springs for retaining the rock arm in a normal position.

Regulation:

REGULATING ADMISSION OF CURRENT TO MOTORS. F. E. Herdman, Winnetka, Ill., 567,714. Filed Dec. 21, 1895.

The field is controlled by a centrifugal governor.

Switches, Cut-Outs, Etc:

ELECTRIC CUT-OUT AND ANNUNCIATOR. J. Kips, New York, 567,599. Filed Feb. 11, 1896.

Embodies the use of a thermostat.

AUTOMATIC CUT-OUT. H. F. Parshall, London, England, 567,608. Filed July 18, 1896.

Adapted for dynamo electric machines.

Telephones:—

TELEPHONE. R. F. Rankin, Philadelphia, Pa., 567,688. Filed Oct. 22, 1895.

Employs a rolling electrode adapted to close the circuit.

TELEPHONE SWITCH. E. E. Ries, Baltimore, Md., 567,794. Filed June 26, 1896.

Details of construction.

LEGAL NOTES.

ANOTHER TROLLEY BASE ORDER MODIFIED.—THE SIMONDS MFG. CO. ALLOWED TO MANUFACTURE.

Last March the U. S. Circuit Court for the Western District of Pennsylvania granted an injunction against the Simonds Manufacturing Company, of Pittsburg, preventing them from manufacturing and selling trolley bases and parts. This order was modified by the same court on Sept. 8, as follows:

"It is not intended by the above order (meaning the injunction order granted March 18, 1896), to enjoin the defendants against the sale of trolley stands, or trolley wheels, or trolley harps, by way of replacing such individual parts in car equipments, embodying the patented combinations, which may have been previously sold by the complainant to purchasers, in cases where such parts have been broken, worn out by use, or are otherwise inefficient, but this permission does not give authority to reconstruct or rebuild a combination which has been sold by the complainant."

We understand that the Simonds Company is now prepared to supply trolley bases, harps, wheels and all parts of the combination to authorized companies.

RIGHT TO LAY ELECTRIC CONDUCTORS.

The right to lay electric light wires in the streets of a city by virtue of a franchise to lay pipes, fixtures or other things for the purpose of lighting the city, is held, in State ex. rel. Laclede Gas Light Company vs. Murphy (Mo.), 31 L. R. A., 798, to be subject to the municipal control of the streets and general police power regulating and restricting the manner in which such wires, tubes and cables may be secured and supported and insulated, especially when the franchise was given before the use of electricity for such purpose was known. The annotation to this case reviews the authorities on police regulations of electric companies.

MAINE RAILROAD COMMISSIONERS REFUSE AN ELECTRIC RAILROAD APPLICATION.

The Railroad Commissioners of Maine, Joseph B. Peaks, Benjamin F. Chadbourne and Frederic Danforth, after a hearing, have refused to grant a certificate that public convenience requires an electric railroad on the highway between Westbrook and Gorham. The application was made by the Portland Extension Railroad Company, and it was argued that, the language of the statute being general, the interpretation of it by the Commissioners should be liberal. The petition was opposed by the Portland & Rochester Railroad, whose track would be paralleled by the proposed new line. The commissioners found no compulsion to exist in the law, and no conditions proved as to need and convenience.

FINANCIAL.

CHICAGO EDISON CO.

In view of the great cheapness of money, President Insull, of the Chicago Edison Company, has for some time past been engaged in work looking to the refunding of its obligations on a better basis, the securities of the company having been issued at a time when the market for such electric lighting bonds exacted a much higher rate. A special dispatch of Sept. 16 from Chicago says: The largest trust deed ever recorded in this county was filed to-day. The deed was by the Chicago Edison Company to the Merchants' Loan and Trust Company, and was for $3,500,000. It is to secure an issue of bonds of that amount. The mortgage is on all the property, real and personal, of the company. The document is dated July 1, 1896.

At the annual meeting of the stockholders in June last the company was authorized to issue bonds to the amount of $3,500,000, with a further issue in the future of $2,500,000, if necessary. The object of the present issue is to refund the present indebtedness of the company.

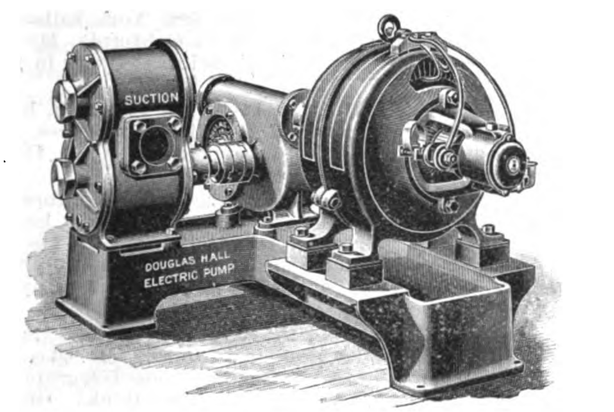
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

DOUGLASS-HALL ELECTRIC PUMP.

THE electric pumping combination we illustrate has been designed particularly for maintaining a supply of water for house purposes, operating hydraulic elevators or for any service where it is desired to elevate or distribute water. Its manufacturers were among the first to adapt the pump to the electric motor, and the present combination represents the result of an extended experience in this line of work.

Any form of electric motor can be used with the pump, that shown in the illustration being of the Lundell type. To the shaft of the motor armature is direct-coupled a two-part worm, one helix being right, and the other left handed. These mesh with two gears, to one of which the pump shaft makes fast. By means of this double worm gearing, end thrust of the worm is entirely obviated. The pump is of the rotary gear type, the action being similar in principle to that of the well-known Root blower. There are two wide gears each having 12



DOUGLASS-HALL ELECTRIC PUMP

deep teeth, the driving gear being of brass and the other one of hard rubber. This, it may be remarked, is one of the oldest types of water pumps, its invention dating from the sixteenth century. In its original form a serious objection was encountered from friction and constant wear, due to the reaction of the discharge pressure. In the present type this pressure is balanced by means of ports or radial openings between each tooth and extending through the gears, the discharge pressure being thus made to act on both sides of the gears, thereby perfectly balancing them. Owing to this ingenious method, the gears are subject to no grinding wear against the suction side of the gear case, and the bearings will run true indefinitely.

The pumping outfit includes an automatic starting rheostat operated by an electrical device at the receiving water tank. The pump described is the invention of Mr. M. W. Hall, and is manufactured by the W. & B. Douglass Co., 87 John street, New York.

THE ARMINGTON & SIMS ENGINE CO.

It will be a matter of great pleasure and satisfaction to a great many people in the electrical field to learn that the Armington & Sims Co., whose suspension was recently threatened by the sudden death of Mr. Henry C. Cranston, the Providence banker, is in excellent shape again to prosecute its business. The financial entanglement of the affairs of the company with those of Mr. Cranston, was most embarrassing, but the officers of the corporation met the situation bravely and promptly by placing the concern at once in the hands of the creditors. An influential committee was chosen, which called in three experts. After a most rigorous examination of the books, and a scaling down ruthlessly of all accounts receivable, the condition of the company was found so favorable, that it was at once voted to continue the operation of the works. The chairman of the Banking Committee, which took this step, was Mr. Marsden J. Perry, president of the Narragansett Electric Light Company, and ex-president of the National Electric Light Association, and it is understood that he will hereafter give a share of his time to the company, a fact that must be regarded as very fortunate, his knowledge of the engine industry and of the lighting business being unusually close and exact. It is a sign of the confidence of the committee that by judicious handling, the company can be carried on with wonted success and prosperity.

It is needless to say that all old orders are to be filled and that new orders are being received in the regular way. The high standard of excellence that has made the Armington & Sims engines famous all over the world will be rigidly maintained, and even raised as opportunity offers and requires. We are glad to learn that the working force has already been increased, and that the demand for Armington & Sims engines is manifesting a briskness which a favorable result to the November elections can but intensify and confirm. It is but fitting to extend to Mr. G. C. Sims, upon whom has fallen the brunt of the recent sudden and severe ordeal, at a time of trade depression when it was hardest to resist, the congratulations of the electrical fraternity among whom he has so many good friends and sincere admirers of long standing.

LOCKE INSULATORS ON HIGH TENSION CIRCUITS.

In our issue of last week we published an interesting article on the Nevada County Electric Power Company, in which mention was made of the pole line, carrying triple petticoat porcelain insulators. We have since learned that this excellent material is furnished by Mr. Fred M. Locke, whose porcelain and glass insulators and steel insulating pins have met with considerable favor in different parts of the country in construction work, and especially for high tension circuits for light and power.

INTERIOR CONDUIT FOR CHICAGO CAVE DWELLERS.

One of the most unique buildings in Chicago will be the banking house now being constructed for the Illinois Trust and Savings Bank. In that city of wonderful sky-scrapers, this building will nestle down with only two stories to its foundation, as the owners have determined to restrict the edifice to the sole use of the bank. Mr. D. H. Burnham is the architect, and it is safe to say that no financial institution in the world will have a building more perfectly appointed for their special needs or more beautiful in artistic design and proportion. This will be one of the notable buildings in the great Western City. The Central Electric Company advise us that it will have one of the most complete electric lighting plants in the city. All the wire will be inducted through iron armored conduit. This will insure absolute protection to the wire so long as the building stands and who can say that it may not endure for a thousand years?

LONG-BURNING ARC LAMPS.

The General Electric Company have recently issued an illustrated brochure on their 100-hour and 150-hour long-burning arc lamps for use on direct current incandescent circuits. The figures given show a remarkable saving in the cost of carbon renewals.

Taking four hours as the average daily run throughout the year on commercial circuits, a lamp which gives 150 hours continuous service will need trimming but eight times per year. As this lamp requires only one new carbon at each trimming, the cost of renewing the carbons will be only twenty cents per year, using the high grade carbons at $25 per thousand.

Ordinary constant potential arc lamps burning the same number of hours will require 150 renewals of carbons, using two carbons at each trimming. At $18 per thousand these would cost $5.40 per lamp per year. The following statement shows the difference in the expense of carbons alone in a plant operating 100 lamps:

Operating 100 ordinary arc lamps, carbons cost per year	$540.00
Operating 100 long burning lamps, carbons cost per year	20.00
A difference in expense per year of carbons alone of	$520.00

Both the 100 hour and the 150 hour lamps are used on 110 volt circuits. A self contained resistance in each lamp lowers the potential at the arc to between 76 and 80 volts. The current used is 5 amperes.

SOUTHERN NOTES.

JOHN WEDDERBURN & COMPANY, the enterprising patent attorneys, Washington, D. C., offered in their series of monthly competitions a prize for the best campaign button. The prize of $150 has been awarded to Mr. S. R. Ireland, of Ashland, Ky., for a "Daisy" free silver button, the center being gold and the white petals around it numbering 16, to signify the obsolete ratio that the Popocrats tie themselves to.

MR. PAUL WINSOR, the treasurer and general manager of the Southern Electric Company, Hoen Building, Baltimore, writes us that his company has just taken over the Morrison Southern Electric Company. The new concern will be in much better condition financially than the old one, and it is expected that things will move very smoothly and prosperously.

LAKE CITY, FLA., is now lighted by electricity, using arcs of 2,000 candle-power and incandescents of 32 candle-power. The plant has been put in by Mr. W. R. Bush, of the Lake City Water and Light Company, assisted by Messrs. Lucius Fielder, E. O. Powers and N. H. Cox. Mr. Powers, who is the electrician of the plant, filled a like capacity at the Ponce de Leon Hotel, at St. Augustine, last winter.

MR. SIMON LAKE, a machinist, and connected with the Lake Submarine Company, is having built at the Malster Shipyards, Baltimore, an electric boat which is intended to assist in wreckage operations. It is to be propelled by steam on the surface, and by storage batteries below.

PHILADELPHIA NOTES.

THE PNEUMATIC TELEPHONE ATTACHMENT COMPANY have filed articles of incorporation at Camden, N. J. The incorporators are E. C. and S. G. Hess, of Camden; C. F. Hess, of Philadelphia, and G. Wells, of Wilmington, Del. The capital stock is $50,000; amount paid in $100.

WESTERN NOTES.

THE WISCONSIN TELEPHONE COMPANY is building a west side exchange at Milwaukee.

THE BELL TELEPHONE COMPANY, of Cincinnati, is building a warehouse and stables to cost $20,000.

THE FORT WAYNE ELECTRIC CORPORATION have been awarded the contract for the electrocution apparatus at the Columbus (Ohio), Penitentiary, at the price of $1,515.

THE BRUSH FACTORY.—A rumor is current in Cleveland and Lynn that the factory of the Brush Electric Company is to be removed to the latter place. No confirmation of the report is obtainable so far.

THE FRASER ELECTRIC ELEVATOR COMPANY has been formed in San Francisco, with a capital stock of $100,000, by E. M. Fraser, G. Crocker, C. E. Green, J. J. Mahon, and A. J. McNicoll.

SONORA, CAL.—The owners of the electric power and lighting plant at Sonora, Tuolumne County, Messrs. Crooks & Jarboe, propose to expend $50,000 in improving the plant and have decided to furnish the power needed direct from the river.

ARMORITE is forging ahead, and rapidly becoming known as a standard for interior conduit work. The Electric Appliance Company are more than pleased with the success of their new specialty, and have increased their stock to supply all demands.

STAUNTON, ILL.—The city council of Staunton will receive bids on Sept. 29 for a municipal lighting plant. Further information on the subject can be obtained from the city clerk or from Bryan & Humphrey, the consulting engineers, Turner building, St. Louis, Mo.

MEXICO.—Orders have been placed with the Westinghouse Electric Company, Pittsburg, and Ball Engine Company, Erie, Pa., by an electric light company at Jalapa, Mexico, for a 350 horse-power tandem compound engine, direct connected to a Westinghouse alternating machine.

MR. ALBERT SCHEIBLE, of Chicago, has been a welcome visitor in the East, where his thoughtful, useful articles on practical electrical topics of the hour have made him many friends. He is on vacation and taking a long rest before he plunges again into the activities of the West.

THE NATIONAL TUBE WORKS, McKeesport, Pa., recently ordered from the Ball Engine Company, Erie, Pa., through their Pittsburg representatives, F. R. Dravo & Co., a 250-horse-power engine to be direct connected to Crocker-Wheeler generator. The combination will be used for power transmission.

BUNKER HILL, ILL.—The Bunker Hill Foundry and Machine Works have put in an electric light plant, with a capital of $25,000, to do local lighting. They have bought a 375-light dynamo from the Colburn Electric Manufacturing Company and have a 45-horse-power engine and boiler. There is about half a mile of circuit.

MR. CHAS. S. BARKELEW, of Middletown, O., has been compelled to purchase some improved machinery for his plant, which has considerably increased his facilities for manufacture. Sales of his dynamo brush have more than doubled during the past two months, which is the best evidence of the entire satisfaction they are giving; and a number of his sales have been to some of the largest central stations in the country. The successful central station managers to-day are those who wish to practice economy in the conduct of their stations, and to such Mr. Barkelew's brushes particularly appeal.

THE CENTRAL ELECTRIC COMPANY, 173-175 Adams street, Chicago, are making active arrangements for a heavy fall business. They do not seem to be devoting very much time to worrying over the financial question, but are "after orders." The country needs light and if it doesn't "see daylight" in November, why, it will take that much more incandescent light to get along. In the "Central's" estimation, the best way to get that is to use Pharos lamps and Wagner transformers, two of their well known specialties. They report a good trade in house goods material. Their Extra B. B. iron box bell has been a revelation to electric bell fitters, as showing how much excellence and good workmanship can be bought for such a small fraction of a dollar.

NEW YORK NOTES.

MR. H. C. TOWNSEND, the patent expert, has just returned home after a prolonged stay in Europe, where he has engaged all summer on some important patent work.

MR. JOHN VAN VLECK, of the New York Edison Company, has been taking his vacation in California. Mr. Frank Van Vleck, his brother, is also an electrical engineer in practice at Los Angeles.

THE AJAX ELECTRIC COMPANY, of Brooklyn, has been formed for the manufacture of electrical appliances, with a capital stock of $50,000. The directors are T. C. P. Horsfield, A. S. Willdig and W. D. Spelman.

MR. J. E. BRIGGS, secretary of the Syracuse Storage Battery Company, was a welcome visitor to New York last week, in connection with important prospective work. He reports closing a contract with the police alarm service of Buffalo for 850 cells of Syracuse battery. This is but one of many recent large orders.

THE FOLLOWING from the New York "Times" may be a "flyer" or it may be something else: Suppose Mr. Geo. J. Gould should sell out his interest in Western Union Telegraph to Mr. W. K. Vanderbilt—what would Wall street think? Once upon a time the Vanderbilts owned Western Union, and it may not be overstrange that one of the family should be willing to take up the property again."

THE SMITH INVESTIGATION has been dragging itself along and several witnesses have been put on the stand, some on the one side to prove that the fire alarm service was excellent and unsurpassed under Supt. Smith's management, and others, on the other side, to prove that the specifications for cable, etc., were so framed that nobody could bid on them with a chance of getting the order, except the Standard Underground Cable Company.

THE GENERAL ELECTRIC COMPANY intends to take an active part in the coming convention of the Street Railway Association at St. Louis. It has engaged a large exhibit space in the Convention Hall, to the left of the main entrance, and will make its headquarters at the Southern Hotel. The major part of its exhibit will be given over to the latest devices for street railway practice. The literature will be of the plain useful kind. The company will be represented by a staff of its best known railway men. Its headquarters at the Southern will occupy the large parlors facing the dining room, and here a hearty welcome will be extended to visitors.

ADVERTISERS' HINTS.

THE C & C ELECTRIC COMPANY address a letter to the trade which is worthy of careful perusal.

DE VEAU & CO. are pleased to send their price lists to possible purchasers of telephones for all service.

THE BERLIN IRON BRIDGE COMPANY make a specialty of fireproof shutters and doors, which have stood some very flattering tests.

THE SILVER AGITATION and its bearing on the use of Electra carbons makes the "ad." of the Electric Appliance Company interesting.

THE SIEMENS & HALSKE ELECTRIC COMPANY invite the attention of purchasers to their generators, lamps, mining locomotives, trolleys, etc.

PLATES OF MICANITE for commutator segments, or stamped to any desired shape may be obtained of the Mica Insulator Company, New York, Chicago and London.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. SEPTEMBER 30, 1896. No. 439.

MISCELLANEOUS.

PROTECTION AGAINST LIGHTNING FOR HIGH POTENTIAL POWER TRANSMISSION CIRCUITS.

BY A. J. WURTS.

POWER transmission circuits do not require line arresters. The points of protection being at the extremities of the system, namely, the power house and motor stations, a group of non-arcing metal lightning arresters, in combination with choke coils, is installed at each of these points. Such a group

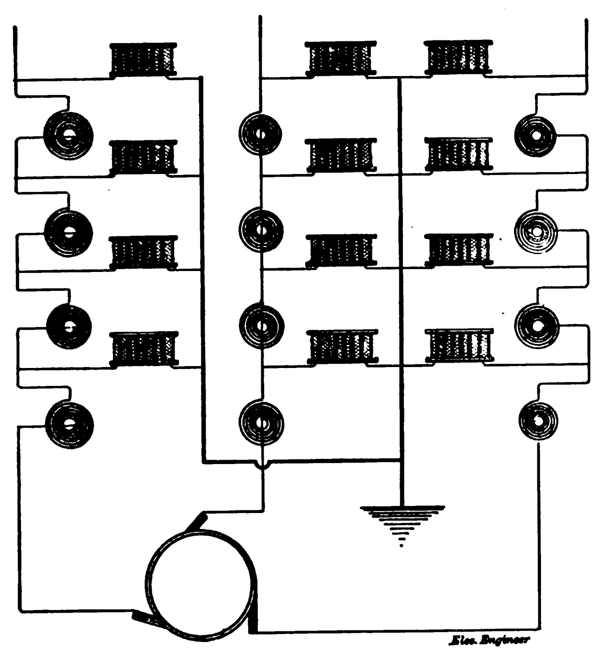


FIG. 1.—CONNECTION FOR 2,000 VOLTS 3-WIRE SYSTEM.

is diagrammatically illustrated in Fig. 1, which represents one end of a 2,000 volt 3-wire system.

To effectively protect circuits carrying potentials of 10,000 or 15,000 volts, it is necessary to use a considerable number of choke coils and lightning arresters. The fact that where these high potentials are used the circuits are usually of great length and especially exposed to the effects of lightning, emphasizes the importance of ample protection. The proper installation of the necessary apparatus has heretofore required a considerable space, and this has led to a more simple combination of choke coils and arresters, called, for reasons that

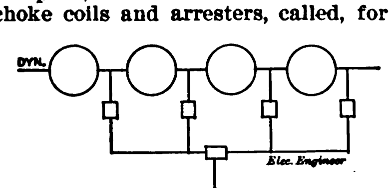


FIG. 2.—CONNECTION FOR 3,000 VOLTS.

will be evident upon inspection of the diagrams Figs. 2 to 6 inclusive, the pyramidal form. This reduces the number of arresters required for the very high potential circuits, without making the protection secured in any degree less effective.

To economize space and facilitate the proper mounting and connections of the apparatus, a rack has been designeu which is illustrated in Figs. 7 and 8.

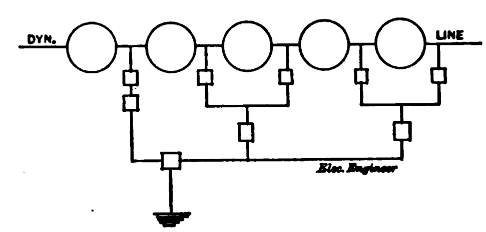


FIG. 3. CONNECTION FOR 5,000 VOLTS.

Figs. 2 to 6 illustrate the pyramidal form of connecting the non-arcing metal arresters for 3,000, 5,000, 8,000, 10,000 and

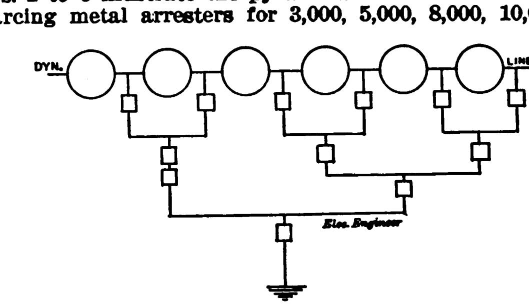


FIG. 4.—CONNECTION FOR 8,000 VOLTS.

15,000 volt circuits, the circles representing choke coils and the rectangles non-arcing metal lightning arresters.

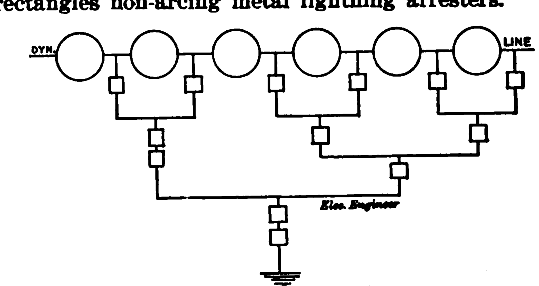


FIG. 5.—CONNECTION FOR 10,000 VOLTS.

To illustrate the great saving in space and number of lightning arresters required by the pyramidal form of connection,

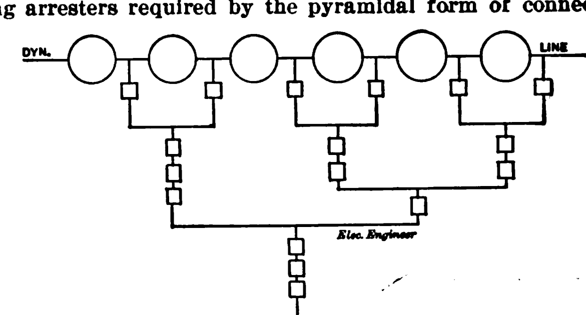


FIG. 6.—CONNECTION FOR 15,000 VOLTS.

it will be noted that in Fig. 6 there are at each lightning arrester connection to the line seven unit lightning arresters between line and ground, making a total of 17 lightning arresters; whereas, with the old method, where seven inde-

pendent lightning arresters were connected between line and ground at each point of connection to the line, forty-two lightning arresters would have been required.

The engravings, Figs. 7 and 8, illustrate the lightning arrester rack, with coils and arresters in position, for one end

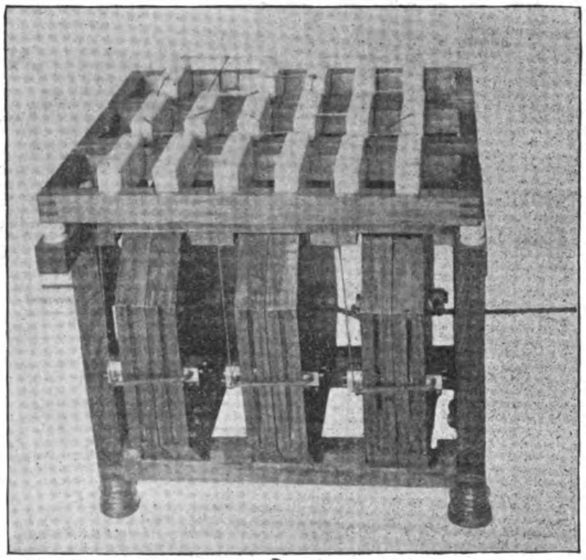


FIG. 7.—THE WURTS PYRAMID LIGHTNING ARRESTER.

of one wire of a 15,000 volt alternating current circuit. The arrangement and electrical connections correspond exactly to those shown in Fig. 6. The connections between the unit lightning arresters on top of the rack are made with No. 10 wire, bent ┌──┐ shape, as shown. Diagrammatical plan view of the lightning arresters and their connections for each voltage are shown in Figs. 9, 10, 11, 12 and 13. These connections correspond respectively to the connections shown in Figs. 2, 3, 4, 5 and 6. For the protection of power transmission circuits, one lightning arrester rack should be connected at each end of each wire, regardless of the number of phases. The

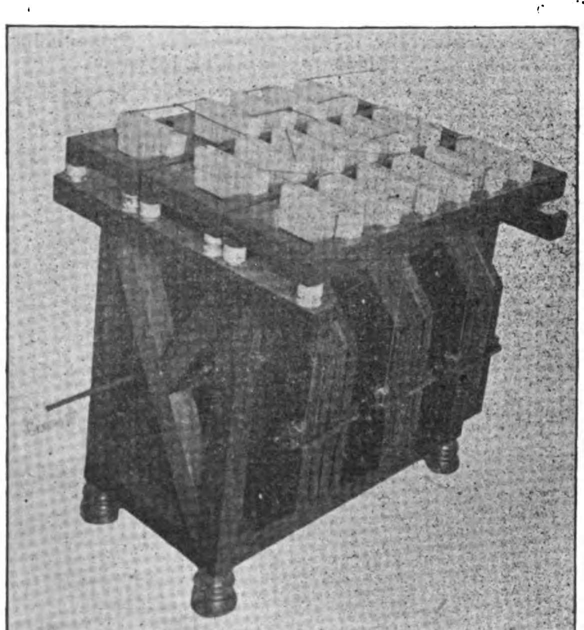


FIG. 8.—THE WURTS PYRAMID LIGHTNING ARRESTER.

apparatus should be located in a dry place and with proper reference to insulation, safety and a good ground connection.

Especial attention is called to the importance of making a thoroughly good ground connection. It is obvious that a poor ground connection will render inefficient every effort made with choke coils and lightning arresters to drive the static electricity into the earth. It is therefore important that we should not only understand how to construct a good ground connection, but also thoroughly appreciate the necessity of avoiding unfavorable natural conditions.

A good ground connection may be made in the following

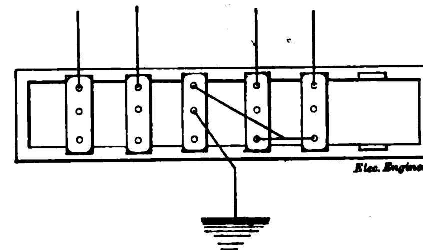


FIG. 9.—CONNECTION FOR 3,000 VOLTS.

manner: First, dig a hole six feet square directly under the arresters until permanently damp earth has been reached; second, cover the bottom of this hole with two feet of crushed coke or charcoal (about pea size); third, over this lay 25 square feet of No. 16 tinned copper plate; fourth, solder the ground wire, preferably No. 0 copper, securely across the entire sur-

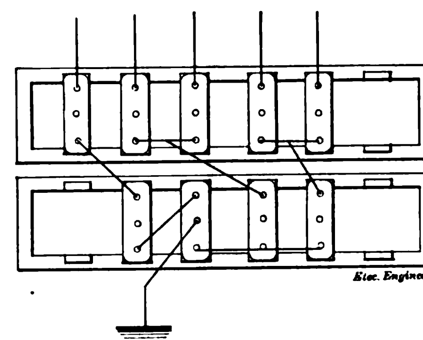


FIG. 10.—CONNECTION FOR 5,000 VOLTS.

face of the ground plate; fifth, cover the ground plate with two feet of crushed coke or charcoal; and sixth, fill in the hole with earth, using running water to settle. The above method of making a ground connection is simple and has been found to give excellent results, and yet, if not made in proper soil, it would prove of little value as a connection to

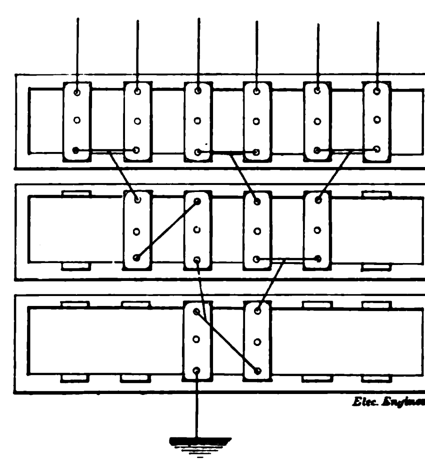


FIG. 11.—CONNECTION FOR 8,000 VOLTS.

earth. Where a mountain stream is conveniently near it is not uncommon to throw the ground plate into the bed of the stream. This, however, makes a poor ground connection, owing to the high resistance of the pure water and the rocky bottom of the stream. Clay, even when wet, rock, sand, gravel, dry earth and pure water are not suitable materials in which to bury the ground plate of a bank of lightning arresters. Rich soil is the best. It is therefore advisable before installing a bank of choke coils and lightning arresters to select the best possible site for the lightning arrester instal-

lation, with reference to a good ground connection. This may often be at some little distance from the station, in which

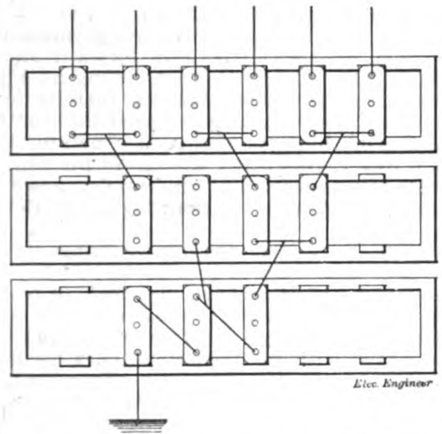


FIG. 12.—CONNECTION FOR 10,000 VOLTS.

case it is of course necessary to construct a lightning arrester house. Where permanent dampness cannot be reached it is

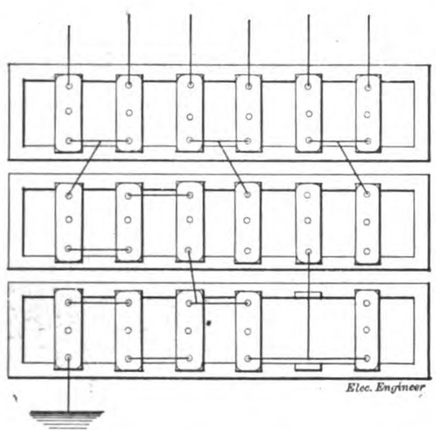


FIG. 13.—CONNECTION FOR 15,000 VOLTS.

recommended that water be supplied to the ground plate through a pipe from some convenient source.

ELECTRIC COAL MINING IN OHIO.

According to the annual report of Mr. R. M. Haseltine, chief inspector of mines of Ohio, 3,120,456 tons were mined by machinery. There are 31 mines in the State equipped with machines. In these 82 of the machines are operated by electricity and a like number by compressed air; 447 hands are employed in operating the machines, and 3,374 hands in blasting down and loading the coal after it has been undercut by the machines.

THE TESTING DEPARTMENT OF THE GENERAL ELECTRIC COMPANY'S WORKS.—IV.

BY THEO. STRAUS.

(Concluded.)

Like the entire works the testing department itself is divided into sections, as referred to above, which form together one great unit.

In each section is apparatus especially adapted for its assigned purposes, and this, together with the facilities for wiring

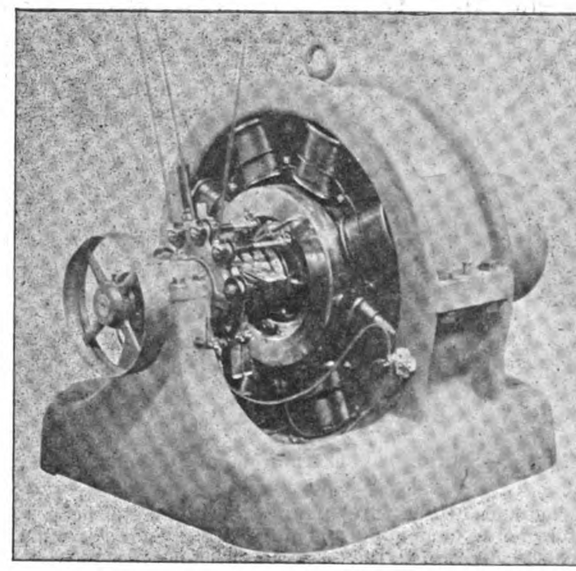


FIG. 8.—THREE PHASE COMPOUND WOUND GENERATOR.

and connecting the machines, enables a test to be run off without unnecessary work.

The diagram, Fig. 7, shows the manner in which the testing building is divided for the various tests, as follows:

(1) Tests of small motors and generators under 25 kilowatts.—Slow and moderate speed direct and belt driven; generators and motors (multipolar and I. B. types); direct connected (blower) motors; direct connected (air pump) motors.

(2) Tests of large motors and generators above 25 kilowatts.—This is the most varied of all the sections, containing all the large machines, both direct and alternating current. Some of these are: Direct and belt driven multipolar, railway and power generators. Multipolar motors.—Slow and moderate speed belt driven generators and motors (multipolar); alternating current generators single-phase, 125 cycles; three-phase generators and synchronous motors, 60 cycles; monocyclic generators, 60 cycles; the 3-phase compound machine is shown in Fig. 8.

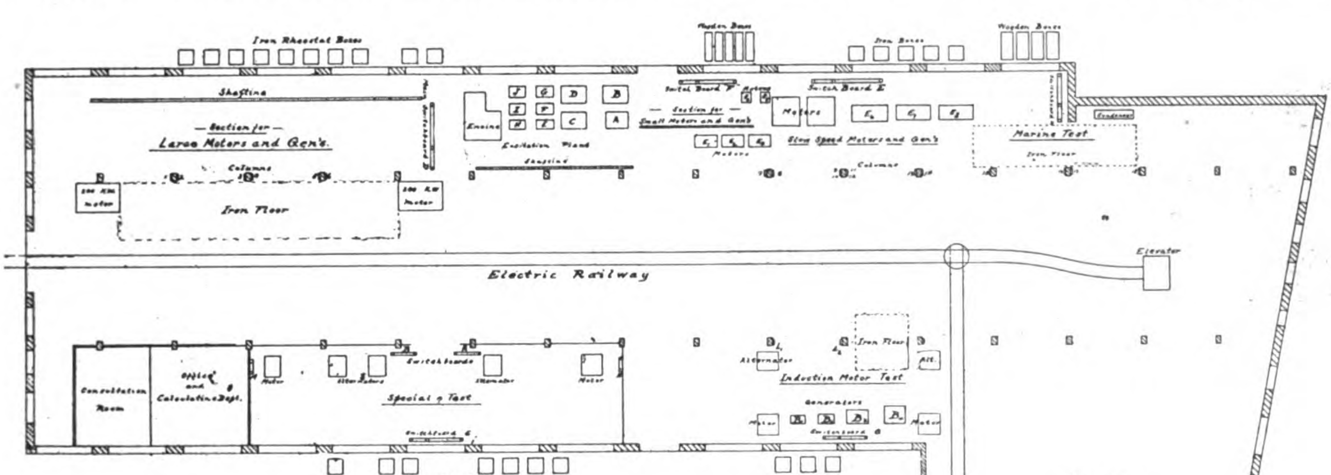


FIG. 7.—PLAN SHOWING ARRANGEMENT OF TESTING BUILDING, GENERAL ELECTRIC COMPANY, SCHENECTADY.

(3) Marine test.—This, as its name indicates, comprises all machines designed for marine work, both for commercial and U. S. Government work. The machines (generators, ironclad motors, etc.) are divided according to the above classification, those for the first class being wound for 110 volts and for the latter, the U. S. standard of 80 volts. The generators are directly connected with vertical double cylinder engines, designed and built by the General Electric Company; a row of these marine units undergoing test is shown in Fig. 9. Tests in this section are therefore both mechanical and electrical

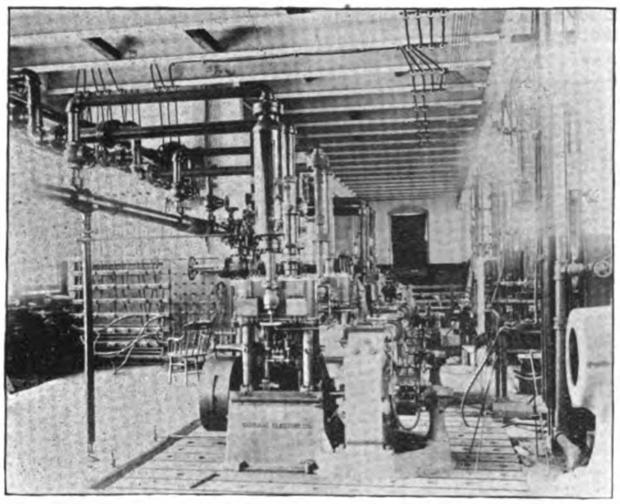


FIG. 9.—SECTION FOR TESTING MARINE GENERATORS.

and permanent fittings are arranged for this purpose. The generators being compound machines, are given the regulation tests, except those for the U. S. Government, which before acceptance conducts through its engineering corps a special series of tests. The engines are first run free (no load) allowing the bearings and cylinders to acquire a good wearing surface. After the governor is regulated so that the change of speed from no load to full load is not more than 2 per cent., the machine is tested. Besides the readings on the generator, the steam pressure and indicator cards (from which the watts per horse-power are calculated) are taken.

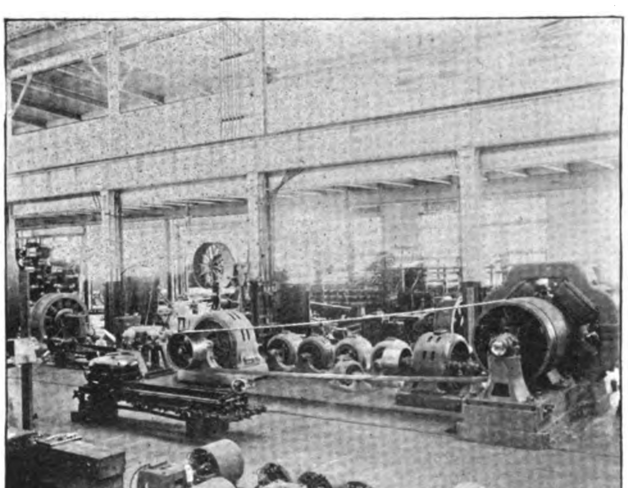


FIG. 10.—SECTION FOR TESTING INDUCTION MOTORS.

Induction motor and potential regulator test.—All induction motors are given a commercial test consisting of the following: Heat run (full load); speed test (no load); speed test (full load); maximum output; magnetizing current; static impedance. This testing department is illustrated in Fig. 10.

The test given to the potential regulators are: Heat run, maximum boost (full load); maximum boost (no load).

(5) Railway motor test.—All railway motors are tested here; these are: G. E. 800, with 2, 3, and 4 turn armatures; G. E. 1,000, with 3 and 4 turn armatures; G. E. 1,200 with 1, 2, 3, and 4 turn armatures; G. E. 51, recently designed especially for the Brooklyn Bridge; N. W. P. 2½, mining locomotives; N. W. P. 12, mining locomotives; N. W. P. 20, mining locomotives; L. W. P. 5, for crane work; L. W. P. 20, for crane work.

In testing these machines two motors of similar type are connected to one axle by gears, as shown in Fig. 11, the same method being used as when the motors are permanently set up in the cars. Then one is run both in forward and reversed directions as a motor, while the other, acting as a generator, sends its current into a water rheostat, thereby loading the motor. After a sufficient time has elapsed the combination is reversed, and the machine running as a generator is now the motor, and the test is conducted similar to the first combination. The tests given are: Heat run (under a severe load); heavy overload; resistance; insulation; high potential (alternating current).

(6) Special test.—Each machine representing its type and class is given a complete set of special tests. They are made most accurately and are correct within a half of one per cent.

The results obtained from these tests are computed by the calculating department, worked up into curves and convenient forms and compared with the theoretical data used in designing the machine. These, together with the general remarks, are embodied in a report and placed on file easily accessible to the engineering corps.

Although the main testing is accomplished in building No. 11, nevertheless, scattered in the various buildings, are individual testing departments.

According to the character of the work produced in the buildings, so are these fitted and arranged as a machine advances towards its final state, piece by piece is sent to these departments and tested. As a result of this very little trouble is developed during the final test after completion.

No apparatus leaves the works, without having some kind of

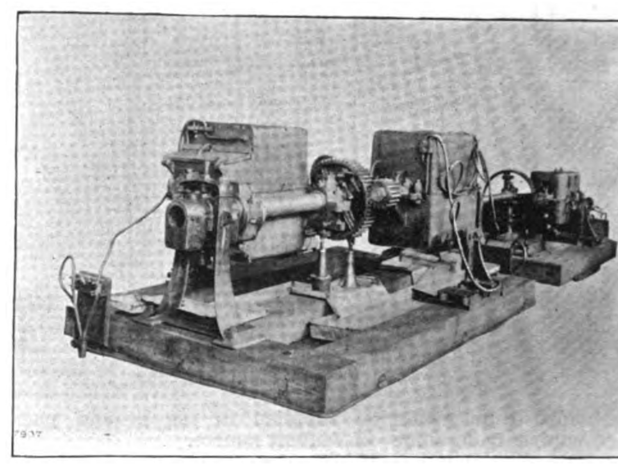


FIG. 11.—METHOD OF TESTING RAILROAD MOTORS.

a test, and if not sent to building No. 11, it is tested in the building where constructed. A partial list under this classification is as follows: Automatic circuit breakers, rheostats, Edison chemical meters, porcelain insulators, controllers, lightning arresters, searchlights, etc.

Like the other parts of the works the testing department is so conducted that nothing is allowed to "slip through" under any pretext, no matter what the cost may be. This is a broad policy, and in the end, as the good results indicate, reaps its reward.

NEWS ABOUT THE AUSTIN, TEX., MUNICIPAL PLANT.

A special dispatch from Austin, Tex., says: At the City Council meeting to-night, Superintendent John Maddox tendered his resignation, and in doing so, in a lengthy communication, he called attention to the inefficiency of the pumps and of the line shafting, which, he said, endangered the safety of the plant. He also called attention to the absolute necessity of removing the plant from the political arena. He characterized some of the dynamos as mere rattle traps and urged the abandonment of the scheme to build a reservoir, and suggested many changes in the shafting and in doing away with belts. The resignation was to take place when his successor was appointed and qualified, but the council upon motion accepted it to take effect immediately.

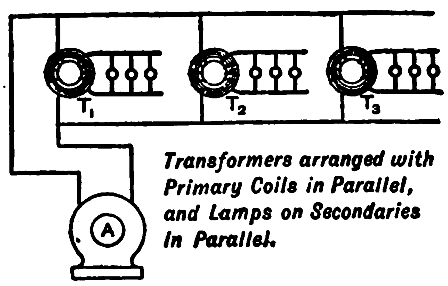
PAWTUCKET, R. I.—The project to establish a municipal electric lighting plant, which has been under consideration in the City Council for the past few months, has been defeated by the action of the Board of Aldermen.

ALTERNATE CURRENT TRANSFORMERS.—VII.

BY DR. J. A. FLEMING, F. R. S.

THE EMPLOYMENT OF TRANSFORMERS.

IN this last lecture I wish to direct your attention to certain problems in connection with the employment of transformers. I shall assume that the majority present are quite familiar with the ordinary methods of distributing electric current by means of transformers, whether by what is called the system of distribution by house transformers, as shown by Fig. 47, or the more modern and economical method by transformer sub-stations. Generally speaking, the method of transformer distribution which is now found to be most practically useful in provincial towns and over large areas is somewhat as follows: In the generating station, the alternators either send their current into one common set of omnibus bars, the alternators working in parallel, from which bars a distribution is made by high tension feeders to various transformer sub-stations. Often a more complicated switchboard is employed in which the high tension feeders coming from the various transformer sub-stations can be connected at pleasure to any alternator, or grouped together in any way on one or more of the alternators. It would be foreign to our subject here, at the present moment, to enter at all into the question of the parallel working alternators. It has been fully discussed in the technical journals and other publications. The high tension feeders are generally arranged to convey a high tension current at a pressure of 2,000 volts to certain transformer sub-stations in which are placed a bank of transformers. These transformers take their primary current through primary switches and fuses from primary omnibus bars connected to the feeders, and the secondary circuits of the transformers are generally arranged to feed a three-wire system of low-tension distribution. For



Transformers arranged with Primary Coils in Parallel, and Lamps on Secondaries in Parallel.

FIG. 47.

this purpose each transformer is provided with three secondary terminals, and from the sub-station proceeds a three-wire low-tension system which is fed by one or more of the transformers, and to which the consumers are connected. In joining up a bank of transformers in this manner it is important that each of the transformers should have an equal percentage secondary drop for the same fraction of a full load. Otherwise, if one transformer has a smaller secondary drop than another, that transformer with the least secondary drop will take the greatest share of the load as the sub-station is loaded up, and it may, therefore, get overloaded and get very hot, and such an inequality of load tends to increase, the more the bank of transformers is loaded up. It is always advisable to examine transformers in this manner, and if any transformer is found to have too large a secondary drop then to remedy it by adding one or more turns to the secondary circuit. In addition to a low tension distribution from transformer sub-stations it is sometimes found convenient to run one or more high-tension feeders to supply the outlying regions of the district which is then served with a system of house transformers. The plan which I have found convenient to adopt in developing an alternating current station in a provincial town in which there is a central shop district, in which the lighting is rather dense, and an outlying residential district in which it is rather scattered, is to arrange one or more low pressure secondary networks on the three-wire system in the central portion of the town. Each of these networks is fed from a single transformer sub-station, and the secondary circuit forms a complete ring main, which is fed into by secondary feeders at three or four places. The transformer sub-stations are inter-connected by a high pressure connecting main, which serves, in case of breakdown at one station, to allow the duty of that station to be taken up by another sub-station. It is not advisable, in my opinion, to connect together the different, separate, secondary networks. One great advantage of the alternating current system is that it enables us by having small secondary distribution systems perfectly insulated from one another, to limit the effect of a dead earth on one of these secondary networks, and that is an advantage which cannot be obtained on the ordinary low pressure system where the distribution network is connected throughout.

As regards the description of cable to be employed, it is now well understood that concentric cable forms in all cases the most satisfactory of cable both for the high pressure and the low pressure conductors. By the employment of concentric cable, we eliminate at once any difficulties which would arise due to induction taking place on neighboring telegraph and telephone wires; and we also largely reduce the inductive drop in pressure which would otherwise exist if the three members of the secondary circuit were separate cables separated by any distance from one another. My own experience is that the secondary network is best laid down by means of triple concentric cable, and there are certain advantages in making the outer member of this cable the middle wire of the three conductor system. In any case, the house connections are quite easily made. It is also desirable to get rid altogether of distribution boxes and service boxes, which become localities in which coal gas can collect and occasionally explode. In laying down the secondary distribution system by means of lead covered and armored triple concentric cable, by far the best plan is to make the proper connection with a service main to each house at the time that the cable is laid, and to have this joint entirely sealed up in lead, making use of no junction box at all, or at most of right angle iron sleeve to mechanically protect the joint. The service main can then be taken into each shop or house, and connected up to the consumer's terminals, whether the building takes light or not. In the central portions of a town it is only a question of time for every shop or house to take the current, and it saves expense ultimately to make this joint in the first instance. The secondary cable having been laid in this manner should be tested, and my own practice is to insist upon a test of 1,000 volts between the different members of the secondary circuit when it is laid in the earth, but before the house connections are made. If the cable stands this test it has a large factor of safety.

ELECTRICITY IN NAVAL LIFE.—II.

BY LIEUT. B. A. FISKE, U. S. N.

THE principal advantage of hydraulic engines over steam and pneumatic engines, arising from the incompressible nature of water, is the absolute rigidity with which they hold the turret. If the valves are closed the turret cannot move; and the turret can never make the water motor go at a greater speed than that for which it is set. In the sighting hood, the continuous turning of a wheel by the operator at any desired speed controls, on the floating lever principle, the speed at which the turret shall go. The muscular effort required is so considerable that he is compelled at frequent intervals to remove his eye from the axis of collimation of the telescope, which is almost fatal to fine shooting. Now electrical men show that they can attain fully as much nicety and precision by electric means, using a controlling switch so easy to move that the eye can be kept continuously at the telescope until the instant of fire; and, furthermore, they proceed to point out how pipes burst and valves leak just when called upon to work. In most, if not all of the plans hitherto tried for electrically training turrets, however, control of the motor's speed has been sought through the putting of more or less resistance in the circuit of the armature. The difficulty of handling large turrets by this means is, of course, great, and the means thus far employed can hardly be called satisfactory. They do not need describing here, because in fact they are bad and should not be used. In determining why they are bad, let us consider what is needed in order to control the training of a turret in a sea-way. The turret weighs a hundred tons or more, and it is rare that its center of gravity is in the axis of rotation. As the vessel rolls from side to side, the turret tends to move by its weight in one direction or the other, the effect being at a maximum when the guns are pointing ahead or astern. Let it be supposed that the turret is pointing ahead and is stationary, and that the turret captain wishes to train it to point at a target on the starboard beam. He moves his lever to the front and the turret starts to turn slowly, the great mass of the turret preventing its suddenly taking up a rapid motion. Just now the ship begins to roll to port and the turret has to climb up hill, besides being accelerated. As the roll continues the hill becomes steeper, until it reaches a maximum, and then it becomes less and less steep, until an even keel is reached. This has taken—say, eight seconds, and the turret has just about reached the speed at which it is intended to run, when the ship starts to roll to starboard; the turret now tends to run down hill, and the motor is doing its best to help it. Evidently the arrangement of the motor must be such that without any conscious effort from the operator, the turret will

not be permitted to run down hill, for the mass is so great that the consequence of mental confusion or inattention on the part of the operator might be serious. In other words, the motor must be arranged so that it cannot run above a certain speed. This is usually expressed by saying that we must use a "constant-speed motor."

It has been objected frequently, however, that constant speed is not needed, or even desired; that what is wanted is simply ability to get the turret quickly around to the target, and to move it quickly to the right or the left in order to keep the guns pointing at the target.

Without wishing to detract in any way from the importance of these points, it must be insisted that everything should be done to make the gun captain's work easy, that his mind should be as free as possible from mental calculating, his lever as easy to move as practicable, and that the movement of the turret should bear a definite relation to the movement of his lever. Let us suppose that this is not done and that the turret's speed depends on other causes than the movement of his lever. Is it not plain that the captain will have to jerk his lever around more frequently and spasmodically than he would if each position of his lever meant a certain speed? If each position of his lever can be made to mean a certain speed, regardless of everything external, is it not plain that with a little practice, and even if the gun captain does not know anything in figures about either the position of his lever or the revolutions of the motor, he will yet insensibly come to feel that he with his own arm is moving the turret, and that his own will controls its speed? Can he not then follow a moving target with far greater precision than would be possible if the turret would spasmodically speed up or down from moment to moment as the ship rolled?

It is not an answer to this to say that it is impossible to get constant speed under the circumstances, that the speed and direction of the turret must frequently be changed, that it will always take a certain interval of time for the heavy mass to make the change, and that during the interval the speed of the turret will be either increasing or decreasing. This objection, while it includes a true statement, is really misleading, because it amounts to saying that, if perfect control of any machine cannot be obtained, we should therefore refrain from attempting to make the control of the machine as perfect as we can. To attempt the control of a turret in a sea-way is like trying to solve a problem containing many variables; and it is axiomatic that the solution of any such problem is easy in proportion to the reductions we can make in the number of variables. Applying this principle, we are forced to the conclusion that the motor for the turret should be so arranged that its speed shall vary as little as possible from the speed set by the gun captain. Now, it is not hard to get a constant-speed motor; but unfortunately for any given electric potential applied to an electric motor, there is only one speed that can be constant; so that, in order to make a motor run at different constant speeds, different potentials must be applied, and each potential must itself remain constant during the interval of time for which the corresponding speed is desired. In other words, in order that the gun captain in the sighting hood may be able really to command the speed of rotation of the turret, he must be provided with a system by means of which the potential which he applies to the motor shall not change, unless he himself intentionally changes it. Reverting now to the statement made before, that all methods of controlling turret motors are bad in which resistances are varied in the armature circuit, we see at once that it must be bad if the potential applied to the armature terminal is liable to change. That it is liable to change is easily proved, as follows:

If an electric motor is running at any speed, and if its load be suddenly increased by any cause, such as in this case, by an increase in the heel of the ship when the turret is running up hill, the motor tends to slow down; this reduces the counter electromotive force that the motor is generating and therefore increases the current in the armature. Now if a certain resistance (say $^1/_{10}$ ohm) has been put in the armature circuit when the armature current was 100 amperes, then, since $E = CR$, the voltage expended in heating this resistance $= 100 \times {}^1/_{10} =$ 10 volts, and the voltage of the armature terminals falls from 80 volts to $(80 - 10 =)$ 70, so that the motor is running really on a 70 volt circuit. Let now the load be increased so that the current increases to say 200 amperes; the voltage now lost in the resistance $= 200 \times {}^1/_{10} = 20$ volts, so that the motor will run at 60 volts instead of 70 volts. The action, then, of an increased load on the motor has been to decrease the power supplied to it, which is just the reverse of what was wanted.

In endeavoring to meet this trouble, Mr. Ward Leonard devised a system which is in use considerably for working large cranes and elevators. By this system the speed of a motor is regulated by increasing the potential applied when it is desired to increase the speed, and decreasing the potential when it is desired to decrease the speed. To accomplish this, Mr. Leonard runs an auxiliary motor direct from the electric mains, and this motor has a dynamo of about the same size on its shaft, so that the motor turns the dynamo and makes it generate a current, which current goes to the armature of the motor that does the work. The magnetic field of this working motor is excited direct from the main circuit, and so is the field of the dynamo which the auxiliary motor turns. But there is a variable resistance placed in the field of the dynamo circuit. Now by putting in more or less of this resistance in the field, the electromotive force, generated and sent to the working motor, is decreased or increased, and the working motor is governed with astonishing precision. As the current, moreover, in the fields is always small, the great difficulty is avoided which always exists in putting resistance into or out of circuits having heavy currents.

One great objection to this method is the obvious one that two motors and a separate dynamo are required to do one motor's work and the additional motor and dynamo must each be at least as large as the working motor. In the U. S. S. Brooklyn, two of the turrets are to be turned by electricity and two by steam, the idea being to have an absolutely fair competitive test under service conditions at sea. A novel plan suggested by the writer is to be tried which need not be described here, as it will not be interesting unless it prove successful.

Besides constancy in speed there are two other principal desiderata in the turning of a turret: first, sufficient speed of turning to bring the guns on to a target, and to follow it when its direction is changing, and second, extreme nicety of movement, which means ability to quickly move the guns in one direction or the reverse through small angles, and to stop it quickly when desired.

In deciding upon the speed required, the question resolves itself merely into deciding how much money and space can be provided for the power, because the highest speed attainable is desired. The speed, however, ought to be at least that necessary when two ships 1000 yards distant are passing each other at fifteen knots each, because this situation may nearly occur. Two ships passing each other at this distance and speed change their relative directions per second through an angle the sine of which is

$$\frac{(15 \times .57)\ 2}{(1000)} = \frac{17.1}{1000} = \sin 1^\circ \text{ (approx.).}$$

This speed is clearly much less than would be required for handling the gun in a sea-way, having regard merely to the uncertain motion of the ship itself. So in our new ships, the speed specified is many times this, even under a considerable heel, when the turret will have to run up hill.

The problem of quickly turning the turret becomes afterwards one for the electrical engineer. He is told that the weight of the turret is so many tons, that the friction is so much, that the center of gravity is so many inches from the center of rotation, and that he must make the turret run at a certain speed. The question is so far one of horse-power. But he must also be told that the motor must be so designed that it will not become stalled (i. e. unable to move) under any probable roll, because, when a motor's armature is stationary the current through it is enormous, being $(C = E \div R)$ that due to the potential between the mains (in the United States Navy 80 volts) and the ohmic resistance of the armature itself. To guard against an excessive current, in case an extraordinary roll should stall the motor, it is well to put an electro-magnetic cut-out in the armature circuit, which will automatically break the current if it exceeds an amount for which the cut-out is adjusted.

As it would be impracticable to provide sufficient power to maintain constant speed under heavy rolls, it becomes necessary to prescribe that the speed shall be constant up to a roll of say 10°, and permit that it may slow down when the angle of heel is greater, being careful that the speed shall never fall to zero under any probable circumstances.

The question of nicety of train, in the case that abundant power has been provided for the efficient rotation of the turret under ordinary rolls, is largely one of the construction of the switch which the gun captain moves. As the gun captain views the target through his telescope, the vertical and horizontal cross wires appear to be describing irregular curves against the background of the sky. His effort must be to bring these curves into the vicinity of the target. Though the motions of the cross hairs are seemingly erratic, they can, of course, be resolved into two motions, one horizontal and the other vertical. If the advance of the ship was in an absolutely straight line, and if the ship rolled the same amount from side to side and at regular intervals, the curve of the point of intersection of the cross hairs would be regular, and it would be comparatively easy to bring this intersection on to the tar-

get. But it is rare that a ship moves exactly in a straight line, in a sea-way, even when steaming on a certain course, for she yaws gently from side to side. Neither does a ship roll regularly. Even under the best circumstances she rolls a little more to one side than to the other, and the rolls vary in amount from time to time. Then a ship frequently comes to rest for a while on an approximately even keel, and then starts to rolling again. Besides the rolling there is also the pitching, and this complicates the motion of the cross hairs, especially when the guns are pointing on the bow or quarter. The up and down motion is the quickest and the most irregular, so that the real problem is to so move the turret as to get the vertical cross hair on the target at the instant when the rolling throws the horizontal hair across the target, and to press the firing button at that instant, changing the elevation of the gun itself as little and as seldom as possible. With a large field in the telescope the vertical wire shows the direction in which to move the turret, even when the horizontal hair is several degrees above or below the target, so that the success of the gun captain, or rather of the man who is charged with the training of the turret in azimuth, in keeping the vertical hair across the target is dependent on the ease with which his switch can be moved, as well as on the response of the motor to the switch; and it is absolutely essential that the moving of his switch must not in the least disturb the position of his eye at the telescope. For this reason the motion of the switch must be to the front and rear, and not to the right or left.

STEERING BY ELECTRIC MOTORS.

This has been accomplished in several vessels, the most recent apparatus being in some "whale-backs" on our great lakes. The writer secured three patents some eight years ago on electric steering, but has not as yet had an opportunity to get his system tried. One of the patents covered broadly "the method of controlling electric motors whereby the motor follows the motions of the operator's hand in speed and direction," just as is done by the ordinary steam steering engine and the ordinary ash hoist. In the "Brooklyn" the experiment will be made of steering by electricity by means of what is called a tele-motor. The apparatus will be installed by Williamson Brothers of Philadelphia, who have made so many of the steam-steering apparatus for our new warships and merchant-ships that they may be presumed to understand the requirements of good steering. There is more doubt, perhaps, about the advisability of using electricity for steering than for any other of the uses to which auxiliary engines are put in ships, because nobody wishes the steering machinery to be otherwise than absolutely reliable, and because steam-steering machinery is now so good that little is left to be desired. Electric steering, therefore, must at present be considered as doubtful, and the burden is on it to prove its value. Meanwhile foreign nations are also experimenting on it; and Messrs. Williamson Brothers do not wish to publish their own plans until they have achieved success.

ELECTRIC FIRING OF GUNS.

When one reflects that a vessel rolls from side to side in about eight seconds on an average, that even under very good circumstances she rolls more than one degree per second, and that with the modern guns an error of ten minutes of arc in the elevation of a gun above the horizontal at the instant it is fired means an error of about 200 yards in the distance the projectile will go, and that in the case of a ship 2,500 yards distant this error of ten minutes of arc will throw the projectile about twenty-two feet above or below the point aimed at, we see that it is necessary to fire the gun in such a way that a less time than ten-sixtieths = one-sixth of a second of time will elapse between the time that the gun captain makes up his mind to fire the gun and the time that it is actually fired; unless the gun captain resorts to the method of firing his gun before his cross hairs rest on the target, by an interval of time which he estimates will be such that when the gun is actually fired the cross hairs will actually rest on the target. Of course, this method is often used with great success, and a "born shot" can, with sufficient practice, so use it; in fact, "born shots" do successfully use it, but only "born shots" can, and even they need more practice than is given or can be given in any navy in the world. To place accurate gun firing within the reach of ordinary men, electrical firing is used, in which the captain can fire without taking his eye from his telescope (or sights), and by such a slight pressure of his fingers that he can fire very quickly after making up his mind to fire, and (which is fully as important) without moving his eye from the telescope. Practical results show more accurate firing with electricity than with either percussion or friction. Complaints are sometimes heard of the untrustworthiness of electrical firing; but if electrical firing apparatus is properly installed, it is more simple and trustworthy than any other means. The real trouble is that as yet there are not enough people on shipboard who understand electrical apparatus. As to the concentration of fire by electricity, it has few friends and they are thinning out rapidly, as the system serves no useful purpose.

The advantages of electrical firing over percussion and friction firing are therefore two-fold. First, the time elapsing between the instant when the gun captain makes up his mind to fire and the instant when the gun is actually fired is very much shortened; second, the gun captain is able to keep his eye on the line of sight until the gun is actually fired, because, since his fingers alone have to act, his head is not jerked to one side, as it is by the physical effort of pulling a lock-string. These advantages are not very evident in the case of firing by the use of the ordinary bar-sight, because the gun captain stands several feet away from it (the bar-sight), and his line of sight is so uncertain that a little more uncertainty does not seem to make much difference. But the whole matter is changed as soon as one comes to look through a telescope sight, because then the line of sight is so absolutely defined that one knows exactly what he is pointing at, and he sees just as soon as he tries to pull a lock-string that by the time he gets the lock-string pulled his telescope sight has been moved by the motion of the ship, so that it no longer points at the same thing at which he pointed when he made up his mind to fire, but points at some other place. A long essay might be written to prove the reasonableness of electric firing, but it would not be half so convincing as a single look through a telescope sight when the ship is rolling, even as slowly as one degree per second. A change of one degree in elevation, let it be remembered, means a change of about 1,000 yards in range on the average.

The details of electrical firing have given a good deal of trouble, but they seem pretty well worked out now. It is to be hoped that every "bug" will soon be overcome, because otherwise (since foreign navies are so successful with electrical firing) the U. S. Navy will have to give up its pre-eminent reputation for fine gunnery. The single wire sytem is the one adopted in our Navy, in which one end of the fine platinum-iridium fuse wire, which is heated by the firing current, is electrically connected to the metallic body of the primer. As one pole of the firing battery is connected to the metallic carriage holding the gun, and as the metal of the primer is in contact with the gun, the circuit is completed when the gun captain presses his firing button; then the current heats the fuse wire, and the heat communicated to the primer ignites it and fires the charge.

The idea so long mooted and so much tried, of firing an entire broadside by the electric current controlled by the captain, seems rapidly falling into disfavor. There are so very many chances of failure, there are so many connections required, and the result hoped for seems so small an improvement over broadside firing by order, that "le jeu ne vaut pas la chandelle."

ON THE NOTATION OF TERRESTRIAL MAGNETIC QUANTITIES.

BY L. A. BAUER.

AT the International Meteorological Congress to be held in Paris, a number of questions of special interest to magneticians have been proposed for discussion, among which is the following: "The same notation should be generally employed, H for horizontal force, X for the northern component, Y for the western component, Z for the vertical force, and V for the potential." As the need of some uniform notation has been made apparent to me in connection with the journal "Terrestrial Magnetism," I have been paying this matter some attention with the view of obtaining a concise and logical system for adoption in that journal.

The principle upon which I proceed is to take the first letter of a word designating a particular quantity, if at the same time it conforms with typographic requirements, such, for example, as declination, which is common to several languages. In this way I have thus far obtained the following: D for declination, I for inclination, H for horizontal component of force, V for vertical component, F for total force. Upon examination it will be found that these letters stand for words derived, in almost all cases, originally from the Latin and Greek languages, and with but insignificant variations in spelling, common to several of the main modern languages.

The Germans will be asked to yield a point with regard to F,[1] but this, as will be seen below, will be made up to them in the adoption of G for magnetic potential. V taken from the Latin vis, or I from intensitas, or D from the Greek word

δύναμις, would not do for force, as they are already taken. Nor would T from totus or P from πας answer, since the former is frequently used for time of vibration, and so in fact is the letter P, which stands besides for the first deflection coefficient. As I hope to be able to find a satisfactory notation for all the principal magnetic quantities, I am keeping this matter constantly in mind in adopting any particular letter. The English and French have force, and I have, therefore adopted F for total force. As it is frequently the custom to designate angular quantities by Greek letters, I should have preferred, had it been possible, to adopt δ and ι instead of D and I, but the Greek ι is a very unsatisfactory letter from a typographical standpoint. Moreover, if found desirable later on, the small letters d and i or δ and ι can be reserved for the variations on the mean of day and on the mean of year respectively.

I think it very much to be deplored if Z, as above proposed, be universally adopted to designate the vertical force. It should not be forgotten that the Gaussian mode of resolving the magnetic force into northerly component (X), westerly component (Y), and vertical component (Z), applies to a local system of co-ordinates, not to a fixed system, as the layman might naturally suppose—a fact which is even apparently forgotten at times by magneticians. The mean values of these components for a complete circuit of the earth along a parallel of latitude can, in consequence, no more be physically interpreted than the mean H, for example. I am, therefore, opposed to adopting for the vertical force a letter which in no way gives evidence of the exact quantity for which it stands. V, on the other hand, is logically connected with H, and at the same time implies that the direction of the quantity that it symbolizes is local, the direction of the vertical or plumbline varying from point to point.

For the same reasons I am not in favor of adopting X for northerly component, and Y for westerly component. Let authors choose this method of notation, if they prefer it; but in a system suggested for universal adoption, it would seem to me that N and W would more satisfactorily meet the requirements, clearly indicating to the eye as they do the local character of the system of co-ordinates employed.

As a letter to designate the earth's magnetic potential, I believe none more fitting could be adopted than G, after Gauss, the author of this function. Gauss himself used V, but this letter is not sufficiently characteristic; it is used to designate many other functions in mathematical physics; and there would, moreover, be a conflict in our system, since V seems the most logical letter to designate the vertical force.

ROENTGEN RAYS.

NEW FORM OF APPARATUS FOR THE PRODUCTION OF ROENTGEN RAYS.[1]

BY BENJAMIN DAVIES.

SOME time in the month of March, this year, after working with various forms of tubes, it occurred to the writer to abolish the glass vessel by converting the ordinary concave cathode into a nearly complete sphere, with the platinum anode at its center. A simple experiment with a Jackson bulb proved that the rays from the anode could pass through the material of the cathode as they would through a similar piece

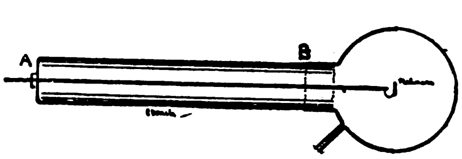
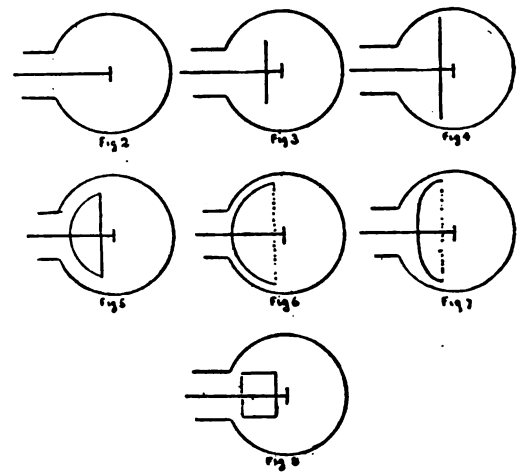


FIG. 1.

of unelectrified aluminum placed outside the bulb. Hence it became fairly evident at the outset that the proposed plan would work to some extent.

Under the guidance of Professor Lodge, and in his research laboratory, experiments were commenced. The first arrangement was a simple one. The sphere was made in two halves, one half of copper and the other of aluminum. The two halves were joined together with marine glue only. The anode was held in position by ebonite fixed in the copper hemisphere. A section of this simple arrangement is shown in Fig. 1. The section is drawn to scale, the diameter of the sphere being two inches. This early apparatus showed signs of success, and it was decided to invest in a larger sphere—one of 3½ inches in diameter. The joints were now made much more carefully, and the apparatus so designed that it could be fitted together or taken to pieces in half an hour's time. The hemispheres of copper and aluminum were soldered together, but the joints (A and B, Fig. 1) were made by compressing India rubber washers by means of suitably made screws. With this convenient apparatus the behavior of various sizes and shapes of anodes was observed. In all the experiments a small thick plate of platinum, having a plane surface of about ¼ square inch, was reserved for that portion of the anode which re-



FIGS. 2 TO 8.

ceived cathode rays; the remainder of the anode was sometimes of aluminum and sometimes of copper. The various forms tried are shown in Figs. 2 to 8.

In Fig. 2 we have the simplest possible anode—the platinum plate alone. It is the same arrangement as that of Fig. 1, the only difference being that of dimensions. This form possessed an enormous resistance, so that only with low vacua could a current be made to pass through. For this reason the behavior of this form was unsteady and its periods of activity very short. With higher vacua and greater potentials, no doubt this form would be more successful. Another form tried was that shown in Fig. 3. The anode here was very considerably enlarged by placing a circular plate of metal just behind the platinum at a place where no cathode rays could fall on it. By this means the area of the anode surface was increased sixteen-fold approximately. The resistance was thereby much reduced, and it became possible to work at higher vacua. This form gave a more powerful and a considerably more uniform radiation than that of its predecessor.

The next step was to increase still further the area of the anode (see Fig. 4.) The anode now nearly filled the sphere. The result, however, was not so good, tending to show that the best size of anode is something less than Fig. 4, and greater than Fig. 2; but Professor Lodge thinks that this is a question of the particular vacuum employed. Another differently shaped anode was next tried. This was formed of a metallic hemisphere with a flat plate in front of it (see Fig. 5). The idea was to get all, or nearly all, of the electric discharge, and so possibly most of the cathode radiation also, to take place between the outer aluminum hemisphere and the anode. The idea probably is a crooked one; anyhow, this form proved less successful than others. The plate was next removed and the hemisphere was replaced by a larger one, as in Fig. 6. For some unknown reason this form gave no radiation whatever, although the vacuum was fairly high. The resistance, however, was low. The experiment was not really a successful one, for there arose some trouble from either small leakages or vapor pressures. The next form was Fig. 7. This gave really bright flashes on a sensitive screen, and the resistance was low. Still another form is that of Fig. 8. The anode now is a hollow cylinder with one end open. The total area of this anode is considerably greater than that of Fig. 3, but the latter gave much the more powerful radiaton. It appears, therefore, that both the size and the shape of the anode have an important influence on the radiating power of the apparatus.

The form which gave the most powerful radiation was that of Fig. 3. This sent a powerful radiation through three feet of solid timber. The rays on emerging were received on a fluorescent screen made of about fifteen shillings' worth of potassium platino-cyanide, and the area of which was 36 square inches. This screen was considerably affected by the rays after having traversed the three feet of timber, and gave sufficient light to see very small objects in. But the hand,

[1] Nature.

when placed between the screen and the timber, cast no shadow whatever.

The next observation on the power of the radiation was to take the screen to a distance of 30 feet from the source. At this distance the bones of the hand could be seen, but not the flesh. Even the bones cast no deep and sharp shadows at this distance, not owing to lack of fluorescence—for the screen was really bright—but owing probably to the turbidity of the intervening 30 feet of air.

The source was afterward placed in position at one end of the laboratory, and the screen taken to the opposite end, or rather to the end of the corridor leading to the laboratory, a distance of 62 feet from the source. Even here the screen fluoresced with some energy, but the hand was observed to cast no perceptible shadow. When this apparatus was working, there was no place within the large room where the screen did not fluoresce, the rays passing through masses of timber and tables with surprising penetration.

This experimental tube, however, with its rubber joints and ebonite insulation, is not a lasting concern. Although a good vacuum can be maintained for hours together when not in work, it will not last more than half an hour or so when in continuous use, after which more pumping is necessary. The current evidently produces some change in the rubber and ebonite, disengaging a gas which slowly destroys the vacuum.

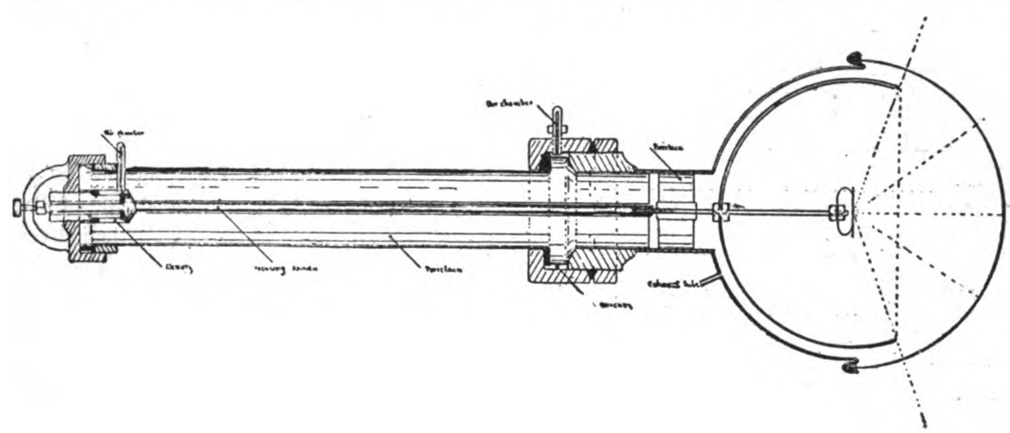


FIG. 9.

In the final instrument the joints are of mercury, and the insulation of porcelain. The joints are first ground and polished and then flooded with mercury. Except the porcelain, the entire apparatus can be made in the lathe, which is a great consideration. A longitudinal section of the instrument is given in Fig. 9. At the end of the porcelain is an arrangement for focusing, which can be manipulated while the instrument is working, so that a point source can be obtained definitely and easily by trial. This figure, which is reproduced from an early picture, has a spherical anode. This should be replaced by a circular plate resembling the anode of Fig. 3.

This last form of instrument, though designed in the middle of May, has not yet been built, owing to the delay in manufacturing the various parts. The parts are easily enough made but manufacturers seldom care to attend to single articles except at their own convenience.

In conclusion it may be stated, though it is unnecessary to do so, that the instrument just described owes its existence to the teaching of Prof. Lodge.

LITERATURE.

LES NOUVEAUTES ELECTRIQUES.—By Julien Lefèvre. Paris, 1896. J. B. Baillière & Co. 412 pp. 5½ x 3¼ in. 157 illustrations. Price, $1.25.

As its title implies, this work treats more particularly of the progress and inventions in the field of electricity which have been accomplished since the Paris Exposition of 1889. In this period, while there have been no new discoveries which have added a new branch to the science such as electric lighting or telephony, there have been a large number of interesting applications of electricity and a wonderful development in several directions. It is with these later developments that the book deals.

The subjects covered include the discoveries by Hertz of electric undulations, the work of Tesla in high-tension alternating currents, the experiments of Ferraris in polyphase currents, and in considerable detail the work of Moissan with the electric furnace.

In addition to these subjects there is devoted quite an extensive description to the progress of electric railway development, central lighting station practice, the Hermite disinfecting process, Röntgen's discovery of the X-rays and a number of the more recent inventions in the electrical field.

The subjects handled are too numerous to admit of more than description and no mathematical treatment is attempted. The book is therefore adapted to the use of the general reader rather than to that of the technical student of electricity.

WESTINGHOUSE ELECTRIC STREET CAR EQUIPMENTS. By F. L. Hutchinson and L. A. Phillips. East Pittsburg, Pa., 1896. Published by the authors. 91 pp. 7 x 4½ inches. 42 illustrations. Price, $1.00.

All electric railway employés should be thoroughly familiar with the apparatus which they handle, and they are generally anxious to learn about the operation of the various electrical devices upon a car; but there has been so far but little literature published which is sufficiently non-technical and simple in its explanations to be of service to the average motorman, to whom this little book is particularly addressed. The authors have endeavored to put all directions, diagrams and illustrations into such form as to be readily understood by any man of ordinary intelligence without previous electrical training. The book treats of the street car equipments manufactured by the Westinghouse Electric & Manufacturing Company and gives directions for the proper inspection and repair of the same, and also explicit instructions for locating and remedying any electrical trouble that may be encountered. The chapters on repairs and on how to locate and remedy faults are of special importance to electric railway men, and the book as a whole will prove a great help to the class of employés to whom it is addressed.

LETTERS TO THE EDITOR.

LIGHTNING ARRESTERS IN THE RAGATZ PLANT.

In The Electrical Engineer, No. 434, I find a description and sketch of a lightning arrester which is attributed to Messrs. Oelschlager-Schrottke. I beg to point out that this form of arrester was used by me several years ago, as may be seen by reference to the London "Engineering" of November 29, 1895, where a description and sketch of it as used in connection with the Ragatz plant will be found on pages 655-6.

Baden, Switzerland, Sept. 7, 1896. C. E. L. BROWN.

CAN AN ELECTRIC CIRCUIT BE OPENED WITHOUT AN ARC?

THE Electrical Engineer of March 18, 1896, has a contribution by Mr. A. J. Wurts, under the above heading. So far I have noticed no response. My answer is, "Yes." It can be done in various ways.

The most convenient method I know of to demonstrate it is to withdraw an electrode through and from a strong solution of the salts of ammonia. In this case the contact is broken among the gas bubbles on the surface; in other words, in an atmosphere that will not support combustion.

For some time past I have expected to bring this theory into practice by using it in connection with my series multiple controller for regulating railway motors.

Denver, Col. J. C. HENRY.

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CONTENTS.

SILVER TO GIVE AWAY.

WE print on another page a most interesting description of the electrolytic copper refining plant, at the Anaconda mines in Montana, this plant being probably the largest of its kind in the world. The processes employed there and elsewhere have added enormously to the quantity of high grade copper made available for the market at low prices, and have had their consequent effect on the electrical trades. But there is another remarkable aspect to the subject, in this year of turbulent national politics. We refer to the nature of the byproducts resulting from the copper refining process. Taking the authoritative figures given for the Anaconda mines, we find them to have a capacity of 200 tons of refined copper per day, but in addition there are given up by the process, which costs only $16 per ton to apply, no less than 350,000 ounces of silver and 1,500 ounces of gold, per month; these precious metals coming in as by-products. Converting these items into dollars and cents, we get, as will be seen, the following figures: Copper, at 10½ cents per pound, $1,260,000 per month output; silver, at 65 cents per ounce, $227,500; gold, at $20 per ounce, $30,000. The Anaconda Mining Company paid a dividend to its stockholders last May of $750,000, and, though we know nothing of its internal affairs, we see no reason on this basis why it should not keep up a good rate of dividend. It is hardly stretching language to say that it has silver to give away.

In view of the enormous bodies of copper ore in sight, and the facility with which it can now obviously be worked to the utmost advantage, can there be any doubt as to the course which the owners of these and similar mines would naturally pursue in the event of the adoption of the silver standard in this country? It is safe to say that such a result at the coming national election as to invite their activity would result in an increase of this indirect silver production of startling magnitude, which, added to the direct production, would in a short time give us a flood of the white metal such as the world has never seen. Regardless of politics, is such a thing to be invited, and if it is to be, what is the use of talking about maintaining national credit, old ratios or raising the price of silver?

The effect on the copper market of such an enormous increase of production can also be well imagined, for, of course, conversely, the copper miner would be able, if he chose, to give away his copper as a by-product, and be handsomely recouped by the silver contained in his ore. We are heartily in favor of anything tending to bring about rational reduction in the price of the materials of construction employed in the electrical arts; but we confess that we would rather see copper back at its old "good times" price, around 20 cents, than note a further reduction on the present low price brought about by a fictitious remonetization whose result would be sheer repudiation in national finance, and would literally tear up every private contract not calling for gold. As an object lesson in the influence of electricity on the value of mineral properties, and the consequent result in bringing about new financial conditions, the Anaconda mines constitute a brilliant example. It is to be borne in mind that electricity elsewhere in mining, by its use of water-powers and by dispensing with the use of costly fuel at lofty altitudes, has brought many low grade mines up to

a basis of profit; and the end is not yet of the use of electric power in such work.

An important detail of the processes employed at Anaconda is the method resorted to for producing the proper toughness in copper required to make good plates, tube and wire in the subsequent working up of the metal in the arts and trades. The Elmore process of subjecting the cathode to a continuous surface-rolling during deposition has not entirely avoided some of the drawbacks to the direct working of the metal as it leaves the electrolytic baths. Among these hindrances, perhaps flaking or foliation of the copper is the most serious. By the application of high pressure jets of electrolyte against the cathode, this defect is now said to be entirely overcome, so that electrolytic copper may be regarded as possessing all the good working properties of the smelted metal and the greater purity in addition. This is one of the improvements to be looked for in the growth of any new process or industry, and in the present case is a decided advance.

CABLES AS POLITICAL LIGHTING CONDUCTORS.

BEFORE leaving Paris Lord Dufferin, the British Minister to France, was given a farewell dinner by the British Chamber of Commerce, at which time he took occasion to refer to the good work done by submarine cables and telegraph wires, in preventing war and in upholding the peace of the world. His attitude was magnanimous, for it is certainly susceptible of proof that electricity has diminished the importance of the diplomatist, by rendering him less important as a go-between and in enabling his principals to get right together quickly. From one point of view, he inclined to regard the telegraph as an element of danger, and said: "Thanks to the telegraph, the globe itself has become a mere bundle of nerves, and the slightest disturbance at any one point of the system sends a portentous tremor through its morbidly sensitive surface. We are told by the poets of old that when Zeus nodded the golden halls of his Olympus shook to their foundations. To-day it would suffice for any one of half a dozen august personages to speak above his breath or unwittingly to raise his little finger, and, like in a heaven overcharged with electricity, the existing conditions of unstable equilibrium which sustains the European political system would be upset, and war, waged in circumstances of greater horror than has been hitherto known to the experience of mankind, might eventually envelop not Europe alone, but two—nay, all the four—continents at once, since in every one of them representatives and offshoots of the contending nations would of necessity be brought into collision."

Perhaps the knowledge that great forces can be set going so instantaneously, by the agency of the telegraph, is itself a check on the ready tongue or hasty temper, if not of the warriors of the daily press, at least of the men who sway the destinies of the nations as rulers and ministers. This, Lord Dufferin admitted, for he went on to say that: "After all, a very thin wire proves a perfectly effective lightning conductor, and for over eighty years, thanks to this unpretending agency, an unbroken peace has been maintained between your native land and the country with whose prosperity and welfare your own interests are so closely associated." In other words, while, as Prince Bismarck once complained, electricity has made diplomacy less "unctuous," it has made it more direct, and has placed the dread responsibilities of peace and war where they belong, not with the diplomat but with his principal, so that they who stir up international strife and try to cultivate prejudices and animosities rather than the comity and amity of nations are known and can be treated accordingly.

LAMP AND SOCKET STANDARDIZATION.

FOR some time past our columns have witnessed the discussion of the subject of standardizing lamp bases and sockets. It is well to have an important subject of this kind agitated, but the discussion is of little use unless it leads to improvement and reform. We are glad to note that President Nicholls, of the National Electric Light Association, has taken the practical step toward settling the question by his letter which appears in this issue. There can be little doubt as to the readiness of the manufacturers to deal effectively with the matter and to reduce confusion to uniformity by the adoption of proper standards. And when the subject of sockets and bases is disposed of—there are others.

ELECTRIC LOCOMOTIVES IN TUNNELS.

IT is said that an official of the Fitchburg Railroad has intimated that at an early day the long Hoosac Tunnel will be worked by means of electric locomotives, just as the Baltimore Tunnel is. Some years ago the electric lighting of the tunnel was accomplished and was considered quite a feat, but the nuisance of the smoke and gas from the steam locomotives remained. The ventilation of the five miles of tunnel would, however, under the new conditions, be vastly improved. As there is abundant water power in the vicinity, the expense of operation should not be large, and the whole train, steam locomotive included, can be picked up at one end of the tunnel and steam shut off until the other end is reached.

People in the Hoosac region are pleased with the news, as well they might be; and we hope the time is not far distant when we shall hear something of similar import in regard to the New York Central Tunnel in this city. That deep cut and hole is a terrible place to go through in summer, and a disagreeable place in any season, and the railroad company would be a gainer, we believe, by enough travel to recoup it for the outlay, if it made the change to electricity.

FIRE PROTECTION OF HIGH BUILDINGS.

AT a recent meeting of the International Association of Fire Engineers, when the question came up of protecting or saving the modern tall office building, the saying was quoted of one fire chief, that they ought to let such buildings burn down to the water reach. This exceedingly cheeky and nonchalant proposition did not meet with general acceptance, nor could it at the hands of any body of progressive men. On the contrary, the opinion was that firemen existed to fight fire and that there were means of getting at a fire even if it was on the top floors of a 150-foot building. For example, attention was called to electric pumps, which could be used at any altitude, and the motors of which could be kept running a long time if necessary. The desirability of keeping the electric light service going was also pointed out, and electric elevators were also noted, the use of an elevator in carrying up a line of hose, instead of dragging it up the stairs being obvious. We have heard recently of one improvement suggested by a fire chief, which consists in having lines of water pipe hidden under the cornices of these tall buildings, the valves to be released electrically at the moment of need, so that flames from outside encounter a complete water sheet which keeps them off.

ELECTRIC LIGHTING.

ELECTRIC LIGHTING IN NEMOTOWN.

BY HARRY N. GARDNER.

FROM week to week The Electrical Engineer presents to its readers descriptions of commercial or isolated lighting plants situated in various parts of the country. As an example of a commercial lighting and power company, the plant and methods of management of the Nemotown Electric Light and Power Company are worthy of brief description, not because of any advanced methods of engineering, or because this plant is particularly different from many others throughout the country, but because a description of no similar plant has before appeared in these pages.[1]

The first noticeable thing which has characterized the management of this company is a careful regard to economy. The Nemotown Electric Light and Power Company is a concern formed by the consolidation of two former rival companies. As it was found more economical to continue using the machinery of the combined companies, not much system in equipment can be expected.

The central station, with some of the interior equipment, was originally the power house of the now defunct first electric railway of Nemotown, bought cheaply by the present owners at sheriff's sale. There have been several additions made to the original structure, built only as the necessity of the time demanded.

The boilers are one 125 horse-power and one 75 horse-power, the original boilers of the railroad company. In their earlier years, these boilers were subjected to very hard treatment, but, with continual repair, it is thought they can be made to do service for several years yet. Besides these, there are one 80 horse-power, two 125 horse-power and a 160 horse-power boilers, which were used by the companies before their consolidation. These, together with one almost new 200 horse-power boiler, complete the boiler equipment.

Originally the coal was stored at one end of the present boiler room; but the installation of additional boilers made it necessary to build a coal room. As the company did not own the land in front, the coal room was built at the rear of the boiler house. The coal is easily shovelled into this room from wagons, and, when needed, the firemen as easily wheel it around to the furnace in wheelbarrows. The same wheelbarrows are also used to convey the ashes to the dump, some distance away.

In the engine and dynamo room is one 300 horse-power Corliss type engine, belted to a jack shaft, to which several dynamos are connected by means of clutch pulleys. Two 80 horse-power and two 100 horse-power slow speed simple engines are connected to another jack shaft, to which the dynamos are connected as before by clutch pulleys. Fixed pulleys connect the engines to the shaft. One of the engines is held in reserve and in case of emergency it can readily be thrown into use by shutting down the others for ten or fifteen minutes, to take off and put on belts. Besides these, there is a 250 horse-power tandem compound high speed engine.

The steam pressure varies from 80 to 110 pounds. As indicators are a needless expense, and take so much of an engineer's time to attend to the readings, the company has never bothered with them. Besides, they have never had an engineer who understood taking indicator readings. It will, therefore, be impossible to give any data concerning economy of engine working.

The 250 horse-power engine is belted directly to a 100 kilowatt, 500 volt power generator and a 120 kilowatt, two-phase Stanley alternator. The other dynamos consist of three old Van Depoele machines, the power generators of the former railroad company, upon which an enterprising "electrician" spent several hundred dollars in trying to rewind them for arc machines (these dynamos are not now in use); two 40-light and one 50-light Brush; one 30-light and two 50-light Thomson-Houston and one 80-light Fort Wayne arc dynamos; and four alternators from 650 to 1,200 lighters, two of which are Thomson-Houston, one Westinghouse and one Slattery.

The switches and instruments are mounted either upon the two panel marble board, or the wooden board beside it, placed at one side of the room.

From the central station the wires are carried to the various parts of town upon poles. It has been found that the strain upon the poles is less (making it unnecessary to set the poles so deeply in the ground) if the wires are not drawn very tight; and upon street corners, where several wires cross each other, it is often impossible to separate them very far. Of course, winds often cause the swaying wires to become crossed; and upon damp nights it may happen that the crossing of two wires produces an arc light for which the city has not contracted, but the company generously refrain from charging for it.

With the combination of the two systems, several years ago, naturally several of the circuits became useless; but as it is unknown when these lines may again be of service, the dead wires have never been taken down.

The transformers, like the station machines, are of several makes, and are for both 52 and 104 volt secondaries. In most cases they are of rather small size. In fact, this company has proved the fallacy of the idea that larger transformers should be used wherever possible; for if a transformer accidentally burns out, with a small one fewer customers are left in darkness, and it is so much easier to replace the small one in such a case. As to the economical advantage of the larger, what difference can there be? If no lights are burning, how is there any current loss?

In most cases it has been found convenient to place the transformer upon the buildings. For residences, a transformer is a decided ornament. If the wiremen can be induced to bring the wires out at the front, so that the transformer can be placed in a front gable, the ornamental effect is greatly increased. Of course,, the tenant may object; but it is easy to "bluff him out" by telling him it has to be put there in order that he may have lights.

In the business portion of town, not only are the transformers placed upon the blocks, but in most cases it has been more convenient to run the secondaries along the front of blocks upon knobs or rubber-hook service blocks. In some cases labor may be saved by running the primary wires from one transformer to another in this way.

Many of the customers have taken out their lights during the last four or five years. But as no one knows how soon the dead wires may come handy, they are never removed. Even where the transformers are taken down, the wooden transformer blocks are left, with the untaped ends of the primaries still attached. If any one should be careless enough to come in contact with these wires, it would probably teach others to be more careful of the "juice." The effect of this system is very pleasing to the critical eye. Thousands of dollars spent in architectural ornamentation could not produce the effect which this company furnishes free of charge.

The underwriters are beginning to object to many things in connection with this system; but insurance inspectors are "a lot of cranks, appointed only to make trouble," and they have to be "stood off" as long as possible. Besides, if the insurance people can be forced to "make a big noise" about the danger, in striving to effect a change, it is so much free advertising, and will greatly increase the condfience of the public in the use of electricity.

The calculation for the service lines is left entirely with the lineman. A conversation recently overheard will serve to illustrate the studious care bestowed upon such calculations. Two linemen were connecting up a residence. In this case the house-owner had objected so strongly to placing the transformer upon the house, it had been necessary to put it upon a pole. The lineman up the pole had asked his companion to send up some wire for the secondaries.

"What size d'ye want, Bill?" was the inquiry.

"Oh, there's a lot of lights in there; better have some number six."

A moment later the other called from the wagon where he was searching: "Ha'int got 'nough six, Bill, here's some number four."

"That's too hard to splice with. Ha'int there some number eight?"

"Nope! Here's 'nough number ten."

"Well, let's have that. Guess that's good enough."

After he had attached the wire to the handline, the man upon the ground called, "Splice them on and come on down. I'm goin' round to Murphy's place for awhile, before we tap in them primaries."

In some cities it is thought necessary to test out a transformer before it is put up. But this company saves the valuable time which others might waste in this manner. A few weeks ago the service in a residence was discontinued on account of trouble caused by grounded wires. A short time after the transformer taken from there was used upon a business street. The next morning the lineman who went to find out the trouble reported from that place, learned that in attempting to turn on lights the night before, one man had been knocked down and another thrown across the room. Had there been worse grounds upon the outside lines, so that the

[1]The details here given are all based on actual observation. With a few changes in name and style of apparatus, the features of central station equipment, as well as the pole and line construction, and business methods, could be shown in different towns.—Author.

men had been killed, the lineman would have learned just as easily that the primary and secondary of the transformer were crossed.

Another way in which some companies waste much time and material is in soldering all joints. This needless expense is all saved by the Nemotown Electric Light and Power Company, for it has been decided that this talk about the resistance loss of unsoldered joints is all "fol-de-rol."

It has also been found much pleasanter for the telephone linemen, or others who may have to climb the poles, if the joints of primaries are occasionally left untaped.

Some companies have considerable time and material wasted in attempting to avoid open circuits upon arc light lines, by taking extra precaution in tying leg wires, reinforcing the wire at certain points, and in other like precautions. The foolishness of such methods is proved by this company, who find that two men can have considerable time to hang around saloons, besides the time they spend in search of open circuits. Besides, it is better to have the lights upon an entire circuit out for a night occasionally, in order that the people may more fully appreciate the advantages of electric street lighting.

Both the contract and meter systems are used for the incandescent and power service; but it has been found impossible to charge a uniform rate in either case. It has been known to afford the deepest satisfaction to a customer to learn that he is paying a dollar a month for the same service for which his neighbor pays fifty cents. It also pleases a house-owner, who was compelled to have a meter put in, to learn that the alderman living next door is able to dispense with this luxury.

It has been found unnecessary to test meters more than to be sure that they register enough. If the meter runs fast enough, the customer is sure to be satisfied. His satisfaction may take the form of objection, when he thinks his bills are too high. But people must have something to "kick" about; if it is not their bills, it is about the unsteadiness of the light. It is known that it greatly shortens the life of lamps to occasionally change the voltage upon the lines. As the company charges for all lamp renewals, this method adds considerably to the revenue in the profit from lamp sales.

Several novel methods of advertising have been inaugurated. One of these consists in using a very small service wire for one part of town, so that during the "heavy load" part of the evening, old lamps give as much as eight or ten candle-power, while the customer only expects sixteen candles. The comparison between a store lighted with these lamps and the one next door, where "Welsbachs" are used, cannot help advertising electricity.

Another fallacy still believed in by some companies, which the experience of this company has disproved, is that it is necessary to have a man who has had some previous electrical or engineering training or experience to manage such a plant. The very efficient superintendent and general manager of this company is a man who had previously demonstrated his ability for such a position by his successful manipulation of ward caucuses, and was chosen for the place because of his "pull" with the political "boss of the party," one of the chief directors of the company. The value of his services at times, when a new street lighting contract is to be secured, because of his "influence" with the aldermen, cannot be estimated.

In the successful operation of the business, he is aided by a carefully selected corps of assistants, each of whom has demonstrated his ability for the position he holds by always voting the right ticket upon election day.

The success of the company has been so great, it is thought the official board can soon support another official, and it is rumored that as soon as the creditors can agree upon a man the company is to have a receiver.

THE SPECTRUM OF REFLECTION AND THE EFFICIENT ILLUMINATION OF CONFINED SPACE.—I.

BY DR. W. H. BIRCHMORE.

THAT colors within a confined space, for example, a room whose walls are covered with a paper of a given hue, are better illuminated and defined by the light of the sun than by any amount of artificial light, no matter what the source, is a fact within the experience of every person; but the laws which may be said to govern the modifications of the various colors by the light of heated carbon have been but little studied and are hardly so well understood the they can be made of any practical value in daily life.

When luminosity is discussed attention is directed almost exclusively to the emission of light, regardless of the part of the spectrum into which such emission falls, while the reaction of the surfaces upon which the light falls, and modification which the light undergoes by such reaction is quite too much neglected.

Doubtless the data are difficult to obtain, but so are really valuable data in other subjects, yet the game is well worth the candle. To determine satisfactorily the reason why with so great an increase in the emission of light our lamps seem to make darkness visible rather than the objects in it seems to be worth all the enormous expenditure of time and trouble it seems destined to cost. The proper execution of the task implies the careful study of many hundred spectra and most careful comparison of the results, not only of one series of studies but of many, for in this way only can the personal equations of men and instruments be eliminated.

In the issue of The Electrical Engineer for January 1, 1896, was published a contribution on this problem, the further elucidation of which this contribution is intended to advance. In this mentioned contribution stress was laid on the great difference in the lights of the sun and those lamps which use heated carbon as a source of light, and the uselessness of trying to increase the luminosity for the red end of the spectrum by increasing the number of rays in the blue was specially commented on. Since then it has been my good fortune to obtain a large amount of new data, much of it quite unique, and from this data to advance the study, I believe, a number of steps.

In the contribution mentioned, reference to and quotations from the extensive study by Meyer into the number (proportionate) of the rays in different parts of the spectrum were freely made, and the composition of certain lights investigated by him was made the basis of the argument. This composition table is as follows, except that the emission of light nearer the "D" lines is made 100 instead of unity in order to be rid of decimal fractions.

COMPOSITION OF SUNDRY LIGHTS PER UNIT OF "D"-LINE LIGHT (Meyer).

Region of Spectrum.	"B."	"D."	"E."	"G."
Sun	407	100	43	15
Day	125	100	50	41
Arc	110	100	40	10
Oil Lamp	66	100	140	100
Carbon Filament	30	100	140	110

These reduced to percentages of the total emission are:

	"B." orange.	"D." yellow.	"E." green.	"G." violet.
Sun	72.0	17.7	7.6	2.7
Day	39.5	31.6	15.9	13.0
Arc	42.3	38.5	15.3	3.9
Oil Lamp	16.2	24.6	34.5	24.6
Electric Incandescent	8.0	26.3	36.8	28.9

From these numerical values the great excess of violet and green rays over those of the other end of the spectrum in carbon lights is very manifest. There exists, moreover, a relation which may very truly be called selective, by which a surface makes choice of the rays it will reflect quite apart from those which the illuminating source emits.

If the power of reflecting light of any given wave length possessed by any surface is made the subject of investigation a numerical value in terms of an arbitrary unit may be obtained, which from analogy to its fellow function may be called the index of reflection. After much study a method was devised which is very simple and eliminates entirely the question of the absolute value of the standard lamps. This index expresses the comparative amount of light of any given wave length reflected from a surface in terms of the amount reflected from another surface used as a standard.

In my studies I have made use of a plate glass mirror as the unit surface. This is the most satisfactory surface available for the purposes of the work contempleted, as it is one readily reached and makes possible the verification of the work I have already done and its construction in other hands.

During the last six months studies have been made to establish the reflecting indices of a number of surfaces of a variety of smoothness and color, and the reflection indices of these surfaces for light in the vicinity of the principal lines of the spectrum have been carefully investigated. About one hundred surfaces have been studied, including cards, wallpapers, drawing papers and the like. These were variously colored, the wallpapers were usually body colored, not printed; the cards were principally approximations to the real colors of the spectrum, while the drawing papers were washed sometimes with anilins in "water megilp" and sometimes with the colors from my color box. The conditions present very soon divided the whole mass into two series, one of smooth and the other of rough surfaces, the smooth surfaces reflecting a continuous spectrum quite apart from the color which they presented to the eye. Thus, a very highly finished card colored red reflected more violet light than a piece of rough paper covered with a wash of manganese violet. In nearly all cases the surface

spectrum, however faint, was continuous, so that no little care was required to be sure that confusion was not given the place intended for order. Incidentally, it was also made clear how little of an excess in the reflection of any ray group produced a distinct hue.

To illustrate this matter by an experience in practical life the following series of indices are chosen for discussion: They are those of the wallpapers in the rooms about me, and are such as an architect would be likely to choose for decorative purposes on the walls of any well finished house. They are all solid colored papers, and are none of them of very smooth surface, and are commercially known as ingrain cartridge papers. The indices are given for those wave lengths only for which the Meyer's equivalents were at hand. These indices were obtained as follows: Two lamps of widely different candle-power were arranged, so that the light of the larger would fall upon a mirror and be reflected into the slit of the spectroscope, and that of the smaller one upon the comparison prisms and be thrown into the slit. An equality of reflection was previously ascertained by rigorous experiment, or rather it was shown by rigorous experiment, that the difference in the two reflections was too small to be observed. Observations were made in various parts of the spectrum and the distances from the slit at which the illumination was equal were accurately measured. The intensity of the lights would then be reciprocally as the square of these distances, and could be represented by the ordinary equations. If now a surface were substituted for the mirror a new relation would be established and by combining these two equations one was obtained from which the reflection index of the light under observation for that surface could be readily calculated. As this method required only linear measures, it was the most simple, and as the instruments used were of the very best, it followed that the results were prima-facie to be relied upon, but when time and again checks were obtained which made the possibility of an error quite of the smallest, absolute confidence and finally almost scientific certainty in the accuracy seemed possible.

REFLECTION INDICES OF FOUR SAMPLES OF WALL-PAPER.

Sample.	A.	B.	C.	D.
"B." rays, orange	0.00095	0.00036	0.00210	0.00214
"D." rays, yellow	0.00067	0.00036	0.00140	0.00272
"E." rays, green	0.00039	0.00048	0.00120	0.00089
"G." rays, violet	0.00028	0.00028	0.00028	0.00028

If these indices be multiplied into the numerical values given in the table for the percentage composition of light, and this product by 1,000,000 to get rid of the decimals, the following numerical values are reached:

NUMBER OF LIGHT RAYS PER MILLION INCIDENT REFLECTED.

Sample.	A.	B.	C.	D.
	(Sunlight.)			
"B." rays, orange	684.0	259.2	1,512.0	1,540.8
"D." rays, yellow	189.6	63.7	247.8	481.4
"E." rays, green	29.6	36.5	91.2	67.6
"G." rays, violet	7.6	7.6	7.6	7.6
	(Electric Light.)			
"B." rays, orange	76.0	28.8	168.0	171.2
"D." rays, yellow	176.2	94.7	368.2	715.3
"E." rays, green	143.5	176.6	441.6	327.5
"G." rays, violet	81.0	81.0	81.0	81.0

These numerical values represent the number of rays of the given wave length reflected from the paper for each million of the given wave length incident thereon.

If it is assumed that the number of wave lengths represents a linear scale, and it lawfully may, then the comparative total reflections from the papers will be expressed numerically as follows, quite regardless of the actual number of rays which may be supposed to represent the ether-impulse:

Sample.	A.	B.	C.	D.
Sunlight	51,143	20,839	237,900	268,800
Incandescent Electric	34,110	27,599	135,424	165,888

These values have been applied in a number of rays to the solution of problems, the results afterward tested by experiments with instruments of precision and the qualities given are unquestionably near enough to be used for practical every-day work. The method is quite arbitrary in conception and in application, yet the results obtained seem to form a rational basis on which to predicate a choice of wall papers and other finishings for rooms in which definite color schemes are to be preserved when artificial light is used.

Of these papers, A, C, and D, are "yellow-red" papers, while B is a "blue-green." The colors used in them all appear to be the same pigments. The basis is a yellow ochre, to which is added raw sienna in case D and red ochre in case A. Prussian blue is added in B. Making imitations on white drawing paper I have been able to reproduce the color schemes of the papers and to check my resulting reflection indices within a very narrow margin. The regularity with which these results can be obtained is an interesting proof that the surface reflection can be eliminated by study and the surface illumination and the color illumination treated separately.

How enormous is the excess of sunlight reflected no words are needed to show, but much more worthy is the part of the spectrum into which the reflection falls. While the sunlight reflection is distinctly orange in its preponderating tone that from the carbon illumination is distinctly a blue-green. Since our notions of color are all formed by the day (sun) light experience, it is manifest that the changed light relations must produce very different color impressions, and daily experience shows that they do.

Curiously enough the changes are toward that common maximum which we call white; yellow is "whitened" by the excessive blue-green, while blue-green is "whitened" by the excessive yellow. In other words, "hypo-chromatic white" is the result. That blue-green rays shining upon a body which has a yellow tinge by sunlight tends to whiten it, is a matter daily observed, but rarely commented on in school experiments and hardly mentioned in school books. Reference is made in Ganot's Physics to the fact that when blue and yellow pigments are mixed green is produced. For example, the water color green pigment called "Hooker's Green" is a mixture of prussian blue and gamboge, and it is also carefully illustrated that when spectral yellow and spectral blue are mixed "white is formed," but there are no deductions made at all commensurate with the importance of the facts in the case. The truth of the matter is that if the entire rays-group from "D" to "G" be added in certain proportions they produce a mean sensation for all colors (pigments) by reflection from which the color sensation disappears, only form sensation remaining, and this also will fail if the contrast of sensation is reduced far enough. Yet this light is ortho-chromatic for certain peculiar tints which reflect no red.

It is important and should be remembered that the common notion that the color we call white reflects all the rays which fall on it in same proportion as they fall, is simply a mistake. The purest white that I have been able to obtain, pure barium sulphate, reflects red much less readily than yellow, and the paper on which this magazine is printed owes its peculiar hue entirely to a small difference in its power of reflecting blue-green, a deficiency as compared with barium sulphate, and n t to any excess in a yellow or orange reflection as compared with the same standard. It will be noticed immediately that in Sample B (a blue-green paper), the number of rays reflected per million incident is decidedly greater by the light of heated carbon than by that of the sun. It is also seen that the amount of violet reflection is greatly increased in all four cases. It is very evident that no augmentation in quantity, that is, candle-power of incandescent illumination, will ever bring out the natural color, the sunlit hue, of objects. In Sample A the carbon light gives no hint of an orange hue, while the yellow is so increased and then neutralized by the blue-green that a solid ivory color results. B really belongs among the "Peacock tints," and so much is the color changed by the carbon light that it is almost sea green in hue.

While the papers thus change, an exactly equivalent tone change, either by contrast or complement, takes place in every color in the room; the warm tones are made gray, while grays are changed to blues and to greens.

At first sight it might be inferred that this evil case could be avoided by using only those colors in which yellow-green and violet are in excess, or by using some form of light other than that of heated carbon, but such solutions do not meet the case at all; the trouble is in the spectral value of all our present artifical lights; improvement can come only by improving the amount of light emitted at the red end.

The idea that a piece of green silk would be more green and less gray by added orange when illuminated by the heated carbon light, seems bizarre, but it is simply the fact.

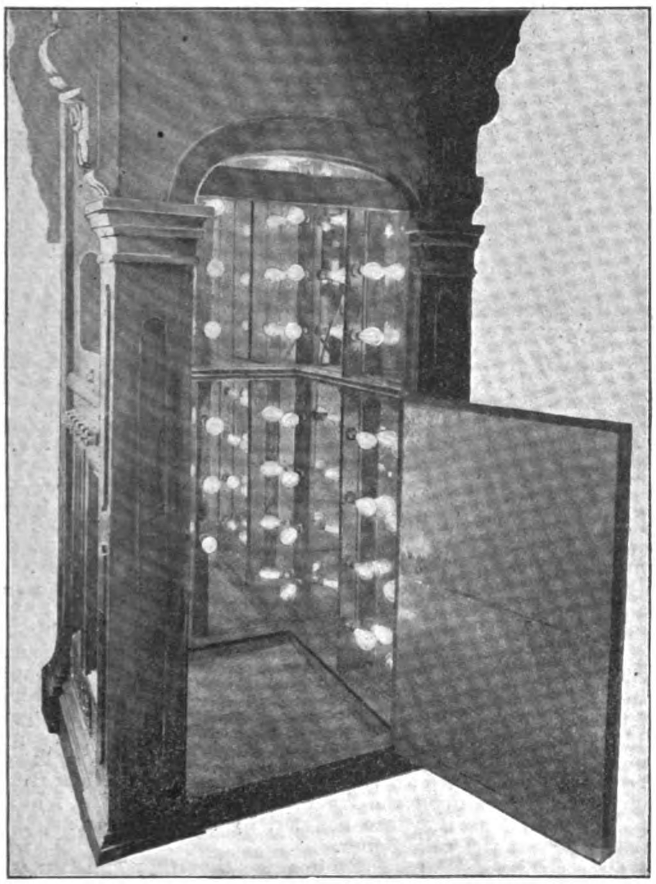
The needed improvement in our lamps is not increased emission, but an emission of different wave length from the present one. Surely it is not in vain that an appeal for a heatable material whose radiation will be of the wave length desired is made to such a race of inventors as this American race has always proved itself to be.

THE WALLKILL VALLEY ELECTRIC LIGHT AND POWER COMPANY have recently purchased a 16 x 36 Corliss engine and have closed a contract with the Fort Wayne Electric Company for a 75 kilowatt alternator. The company is in the market for electrical equipment of any sort. Address A. J. Fowler, secretary.

THERAPEUTICS.

THE INCANDESCENT ELECTRIC LIGHT OR RADIANT HEAT BATH.

THE influence of the electric light on the growth of vegetation and living organisms is now a matter of common knowledge, Sir William Siemens having as far back as 1880 first called general attention to the stimulating effect of the rays from arc lamps. Later experimenters have confirmed these results, but it has only been comparatively recently that the subject has been taken up seriously with a view to its application in medicine as a therapeutic agent. This work has



THE KELLOGG ELECTRIC BATH CABINET.

been carried forward to a remarkable extent by Dr. J. H. Kellogg, superintendent of the Battle Creek, Mich., Sanitarium, a famous Western health resort, at which place the electric light, or, more properly speaking, the radiant heat bath, is now in extensive and highly successful use for a variety of ailments, as a substitute for the Turkish, Russian, vapor and hot air baths, previously employed. The results of extended and accurate tests have shown that the radiant heat bath acts to increase the elimination of carbonic acid gas expired, while it decreases the amount of urea, total chlorides and total solids in the urine.

The accompanying engraving shows one form, the upright cabinet type, of bath employed by Dr. Kellogg. This consists of a cabinet about eight feet in height containing about sixty incandescent lamps arranged in rows, the spaces between the lamps being filled with silvered glass. The cabinet is freely ventilated, and by means of switches the number of lamps can be varied at will. Other forms of bath for special application to spine, legs and feet, trunk, etc., are also in use.

The peculiar value of the electric light bath Dr. Kellogg considers due to its efficiency as a source of radiant energy. In this respect it differs radically from the Turkish or Russian baths, in which heat is brought to the body by convection of air only. Air, being a poor conductor, communicates heat to the body very slowly. Absorption of heat is further hindered by the skin, an excellent non-conductor, and by the rapid evaporation of moisture on the skin, which latter action cools the body rapidly. The heat from the incandescent lamps, on the contrary, is of the radiant form and penetrates the skin and tissues much in the same way as the light rays from the same source pass through the tissues and cause them to appear translucent.

As confirming the correctness of the above assumptions, it may be stated that with the incandescent lamp bath, the time required to induce perspiration was 3 minutes 32 seconds, while the average temperature within the cabinet was only 81 degrees Fahrenheit. With the Turkish and Russian baths the time required was respectively 5½ and 6 minutes, while the temperatures were 128 and 101 respectively.

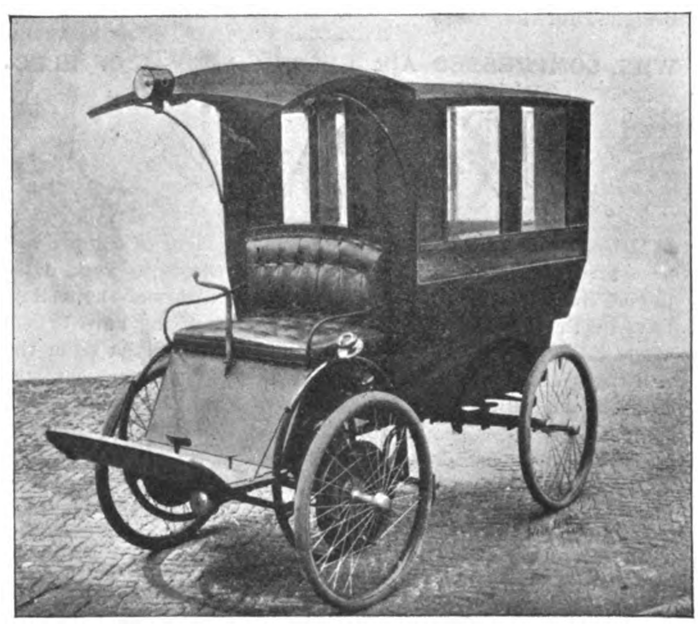
Dr Kellogg has found the electric light bath, upon which he has taken out a patent, of far greater value in the treatment of a great variety of maladies than any other means of applying heat, except water, and believes that it may be much more generally employed than the Turkish, Russian, vapor or hot air baths. The degree of heat can also be regulated with the greatest nicety, a matter of considerable difficulty with the other forms of bath.

ELECTRIC TRANSPORTATION.

THE MORRIS & SALOM ELECTRIC CARRIAGES AND WAGONS.

AMONG the vehicles which took part in the recent motorcycle contest at Providence was one built by Messrs. Morris & Salom, of Philadelphia, which won the distinction of making the best speed thus far recorded for this class of conveyances. This was during the last of the three heats, when the Morris & Salom motorcycle made the extraordinary time of 11 min. 27 sec. for five miles, or at the rate of twenty-six miles per hour, the average time for the five miles being 2 min. 17.4 sec. per mile.

It is of considerable interest to observe that this record was made with two 1½ horse-power Lundell motors as against the



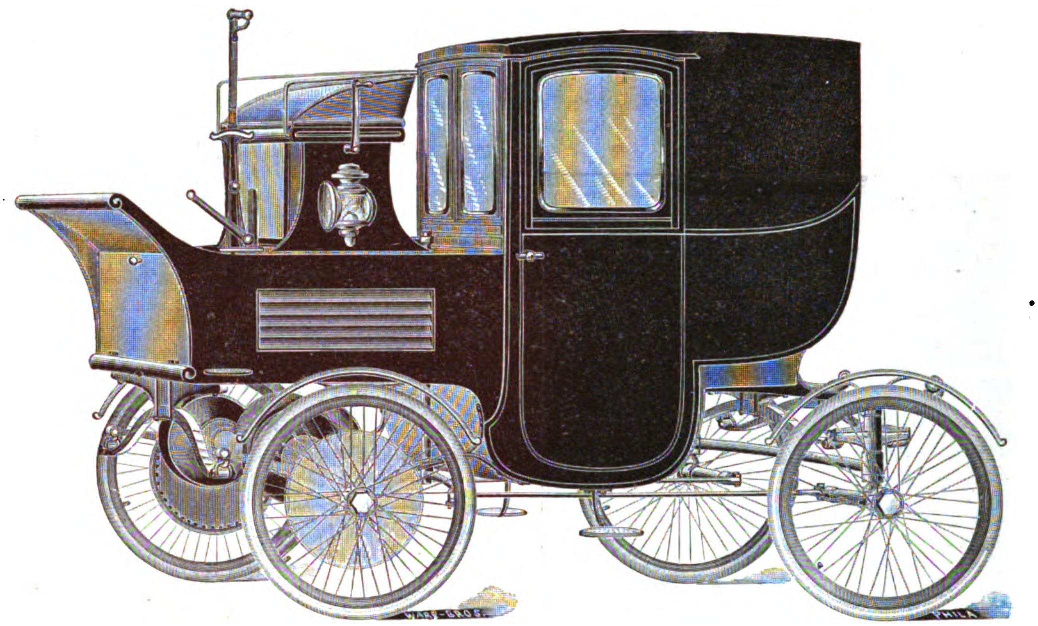
THE MORRIS & SALOM ELECTRIC DELIVERY WAGON.

5 brake horse-power engines on the gasoline-driven vehicles entered in the same contest, which, it is understood, can be worked up to 10 horse-power. Messrs. Morris & Salom, whose work in this field dates back several years, are more than ever convinced of the commercial possibilities of the electric motorcycle. They are not attempting at present to fill individual orders for carriages in various parts of the country, as they consider such a scheme impracticable, but are confining their attention to building a number of electric hansoms and coupés for public service either in New York City or Philadelphia, types of which are illustrated in the accompanying engravings. When they have demonstrated the commercial success of a system of this kind, it will, they assert, be an easy matter to establish stations in every large city in the

Union where a private individual who desires a carriage can have it properly charged and cared for.

These various vehicles will have a capacity of twenty-five or thirty miles on one charge, over ordinary city streets and roads, and the cost of operating, when power is supplied by the owner and not from a central station, will not be more than fifty cents per day, including renewals of batteries and necessary repairs on the vehicle.

The carriages are each supplied with two 1½ horse-power Lundell motors and forty-four chloride cells of a special type designed for this work.



THE MORRIS & SALOM ELECTRIC COUPE.

WILL COMPRESSED AIR BECOME A RIVAL OF ELECTRICITY IN THE RAILWAY FIELD?

Wm. Baxter, Jr.

THOSE who are interested in the development of compressed air motor cars, as well as some of the New York daily papers that have been the strongest antagonizers of the trolley, have for the past two or three months been working hard to convince the world that electricity will soon be driven from the railway field. From the hour when the experimental car was first started, on the 125th street line, in New York, it has been claimed by these people to be a complete success; but the mere fact that the car will run is no proof that it is even partially successful, much less that it is superior to the trolley cars. If compressed air cars can meet with success anywhere, they certainly will in this city; and especially on the road where the experiment is now being tried. The traffic on this line is only moderately heavy, and the grades and curves are almost insignificant; therefore, the maximum effort, as well as the average power required to propel the car must be very low, and this is a great advantage for a car that is run by stored energy.

The promoters of the compressed air system have endeavored to prove its value by making numerous claims that a proper investigation will show are not well founded; and those who have undertaken to show that the electric system is in no danger of being driven from the field, have, in most cases, failed to detect the weakest points of their opponents.

The claims put forth by the compressed air advocates are that the system is still young but that when it has had as much money and brains spent upon it as the electric, it will be in undisputed possession of the field; that with it the strain on the track is very much reduced, and that on that account the ordinary horse car tracks can be used; and, lastly, that no trolley line is required, and that each car is independent of all the others.

The claim that the compressed air system is still young, is not correct, except in so far as it refers to the present experiment; it has been in use for many years, and whether it has had as much money spent upon it as the electric, or not, it is certain that it has occupied the attention of many of the most able engineers of the world, from a time that antedates the advent of the electric motor by a large portion of a century. It may be claimed that its use has been confined to other fields than that of railways, and that on this account it has not advanced much in the latter, but perfection is as essential in other fields as in the railway, and any improvements made in these would be of corresponding value in the latter. It is not true, however, that it is new in the railway field. It was tried before the days of electricity and at numerous times since then, but it has always failed.

The claim that the strain on the track will be less with compressed air cars has no foundation to stand upon, and is based wholly upon the fact that the first trolley cars were equipped with very heavy motors, so mounted that more than one-half of the weight rested upon the axle. The cars of to-day are provided with motors that weigh about 1,500 pounds each, and so suspended that all, or nearly all, the weight is taken off the axle. Compressed air cars cannot do more than this; therefore, their effect upon the track, weight for weight, will be the same, and as they are heavier, by about two tons, they will wear out the rail sooner.

If the compressed air people imagine that they can run cars on the ordinary horse car tracks, they are doomed to disappointment, as they will find out in time. The rails used on those roads are not any heavier than is necessary for the light weight cars used on them, when run at a low velocity, and even if the weight were not increased, the roads would soon give out if the speed were increased to that of trolley roads. If the weight were made three times as great, and the speed were at the same time increased, how could the tracks be expected to last, when they are hardly substantial enough for the present work, as is demonstrated by the fact that very few of them are in fit condition for cars to run on at the speed adopted on electric roads.

The assumption that doing away with the trolley line is a great advantage is in part justifiable, but the gain would not be anything like as much as would appear at a first glance. The cost of the line, and the maintenance thereof, would in all probability be offset nearly, if not wholly, by the increased cost of the compressed air station equipment, and the greater expenditure for repairs.

The compressed air advocates say, that the fact that the cars have to be recharged is no objection, because the operation only requires a few minutes, and that locomotives have to stop to take on water and coal; but they should remember that they are not competing with locomotives, but with electric cars, and these do not have to stop for such purposes. It is claimed that it only requires six or seven minutes to recharge a car; but if the time lost in switching, from the main line at the charging point and back, is included, the six or seven minutes may become ten or fifteen, and in the course of a day these losses would run up to a formidable amount of time.

The defenders of electricity have, generally, taken the view that the efficiency in the conversion of energy is the all-important factor, and that all that is necessary is to show that electricity is superior in this respect. This view, however, is not wholly correct; efficiency is one of the factors that determine the relative merits of the two systems, but it is not the only one, and perhaps not the most important one. The reliability of operation, the cost of repairs, the frequency of breakdowns and the ability to meet the requirements under all conditions of load, are points of fully as much importance as the cost of power delivered at the axle.

As to reliability of operation, it cannot be expected that the compressed air cars will do any better than locomotives would, in the same class of service, and, certainly, they will not do as well, unless equal in design and construction. Locomotives are reliable on steam roads where the rails are high above the ground, and the mechanism can be kept clean, but in all the attempts that have been made to use steam for street car work, one of the greatest difficulties encountered has been the rapid destruction of the moving parts on account of their being constantly covered with mud and grit. The reliability of a locomotive is due not altogether to the fact that it runs on a track where it can be kept clean, but also because the distance covered in a single run is short, and it is then thoroughly cleaned and examined before being used again. The motors of a trolley car are never cleaned, in the sense in which a locomotive is, and instead of making short runs, are kept in service from eighteen to twenty hours per day. If compressed air cars are run under these conditions, they will surely break down very frequently, unless they are far more perfect than locomotives in their construction, and this is not at all probable. It is reasonable, therefore, to assume that unless more time, which means more money, is spent on the compressed air cars they will give out oftener, and, therefore, will not be as reliable. The cost of repairs must necessarily be greater, inasmuch as the parts that wear out are more costly.

One of the peculiarities of electric cars that has had much to do with making them a complete success is the fact that they cannot be stalled by any amount of load, they may be called upon to carry. This much may also be said of the compressed air motors, providing they are called upon to make a great effort of short duration, but if the time is prolonged, the supply of compressed air will be rapidly reduced, and the reserve capacity may be exhausted before the charging station is reached.

It is very probable that compressed air motors can be made sufficiently perfect to gain a foothold in places where the trolley is not allowed, but to compete successfully with it, they must be as capable of withstanding hard usage, and as reliable in their operation under all conditions. In addition to this, the total cost of plant must at least not be any greater, neither must the cost of repairs, and to this we may add that the cost of energy per passenger mile must not be any greater. As the cars are heavier, the energy consumption, and, therefore, cost, per unit of revenue-earning load carried; can only be reduced to the standard of the electric system through a higher efficiency, and it is difficult to show that the efficiency is equal, much less higher. Unless the efficiency is as high, the capacity of the station will have to be greater, and hence, the cost of equipment more, assuming the compressors to cost the same as the generators for equal capacity, but they will very likely cost more. The car equipments will also probably cost more, and the excess of cost in station and car equipment will probably equal the cost of trolley line.

In the cost of plant, therefore, there appears to be but little room for gain. The cost of maintenance would certainly be greater, and as there is very little doubt as to the efficiency being lower, the operating expenses would be greater.

If all the foregoing is true, compressed air has very little upon which to hang its hopes of becoming a successful competitor of the trolley.

THE BRAKE HANDLE BAROMETER.

"This rain is about over," said a motorman on one of the open cars yesterday afternoon.

"Are you a weather prophet?" was asked.

"I think I am, as far as dry or wet weather is concerned," he replied. "I can tell whether we'll have rain within twenty-four hours or not.

"How am I able to do it? Well, it's like this: When it's going to rain the brake-handle becomes sticky almost a day before. The motorman will first notice it fully twenty hours before the storm arrives. You can just barely notice it then, but the stickiness will increase until it will be almost impossible to get a decent grip without tearing the flesh on your hands. Now, on Friday night, I began to feel that sticky business, and I told a fellow who was on the seat behind me that it was going to rain. The sky was clear and after he glanced around he said that I was away off. I said, 'I don't say it's going to rain right away, but it will before this time to-morrow,' and it did. Oh, there's no going back on the brake as a barometer."

At this point in the motorman's remarks a passenger boarded the car. The front seat was about filled, but that did not matter. He wanted to talk with the motorman.

"Is the rain all over?" was his query.

"Pretty near," answered the electricity pusher.

"Well, I'm glad of that. Do you know," continued the latest arrival, "I place more confidence in a motorman's prediction than I do in those made by the weather signal man?"

The motorman blushed becomingly.—Albany (N. Y.) "Argus."

A LINEMAN'S LAP was the post selected at Hoboken last week by a woman who wanted to stop him from digging a trolley pole hole in front of her house. She stayed in his lap very comfortably for an hour, to the intense delight of the crowds. What the man said is not recorded.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The first meeting of the season was held at 12 West Thirty-first street, New York, Sept. 23, at which President Louis Duncan delivered a very able and interesting inaugural address, the subject being the "Present Status of the Transmission and Distribution of Electrical Energy." Messrs. Steinmetz, Wolcott, Lamb, Perry, White, Ries and others took part in the discussion.

At the meeting of the Executive Committee in the afternoon the following Associate Members were elected: H. G. Brinckerhoff, Electrical Engineer, Metropolitan West Side Elevated R. R., 258 Franklin street, Chicago, Ill.; H. G. Meadows, Associate Engineer (Elec.) with Newcomb Carlton, 109 White Building, residence, 114 West Chippewa street, Buffalo, N. Y.; F. J. Newbury, Manager Insulated Wire Dept. John A. Roebling's Sons' Company, Trenton, N. J.; Julio Pinkas, Director General, State Telegraphs and Telephones, Sucre, Bolivia; C. W. Richards, Partner, Cumner-Richards Company, 69 Broad street, Boston, residence, Needham, Mass.; C. G. White, Public Schools Supt., and Instructor in Physics and Chemistry, Lake Linden, Mich.

SOCIETY OF ARTS PRIZE ESSAYS.

Notice is given in the current number of the "Journal of the Society of Arts," London, of two prizes offered by the society. One is the "Fothergill" of £25 and a silver medal, for a paper on "the best means of effectually preventing the leakage of current to earth in electrical installations from generating heat and setting buildings on fire." The paper should consist of about eight thousand words, and be written with a view to being read and discussed at an ordinary meeting of the society. Papers submitted for the prize must reach the secretary by October 1 of this year. Each paper must be typewritten, and bear a motto, the name of the writer being inclosed in a sealed envelope, with a similar motto. The other prize announced is a gold medal and the sum of £20, and is to be bestowed, under the terms of the Benjamin Shaw Trust, "for any discovery, invention, or newly devised method for obviating or materially diminishing any risk to life, limb or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means." Descriptions of the inventions of intending competitors must reach the secretary of the Society of Arts not later than December 31, 1896.

STANDARDIZING LAMP BASES AND SOCKETS.

Mr. G. F. Porter, secretary of the National Electric Light Association, has forwarded us a copy of the subjoined letter, which has been sent out calling a meeting of lamp and socket manufacturers:

New York, Sept. 24, 1896.

Gentlemen:—I beg to advise you that a meeting of manufacturers and central station men to discuss the possibility of standardizing the incandescent lamp base and socket, has been called for Thursday, the eighth of October, commencing at 10:30 a. m. The meeting will be held in the rooms of the American Institute of Electrical Engineers, which are situated on the tenth floor of the Havemeyer Building, 26 Cortlandt street, corner Church, this city.

I may say that every manufacturer previously advised of the intention to hold a meeting has notified us of their desire to be represented. Yours very truly,

FREDERIC NICHOLLS, President.

Electro-Deposition.

THE ANACONDA ELECTROLYTIC COPPER REFINERY.

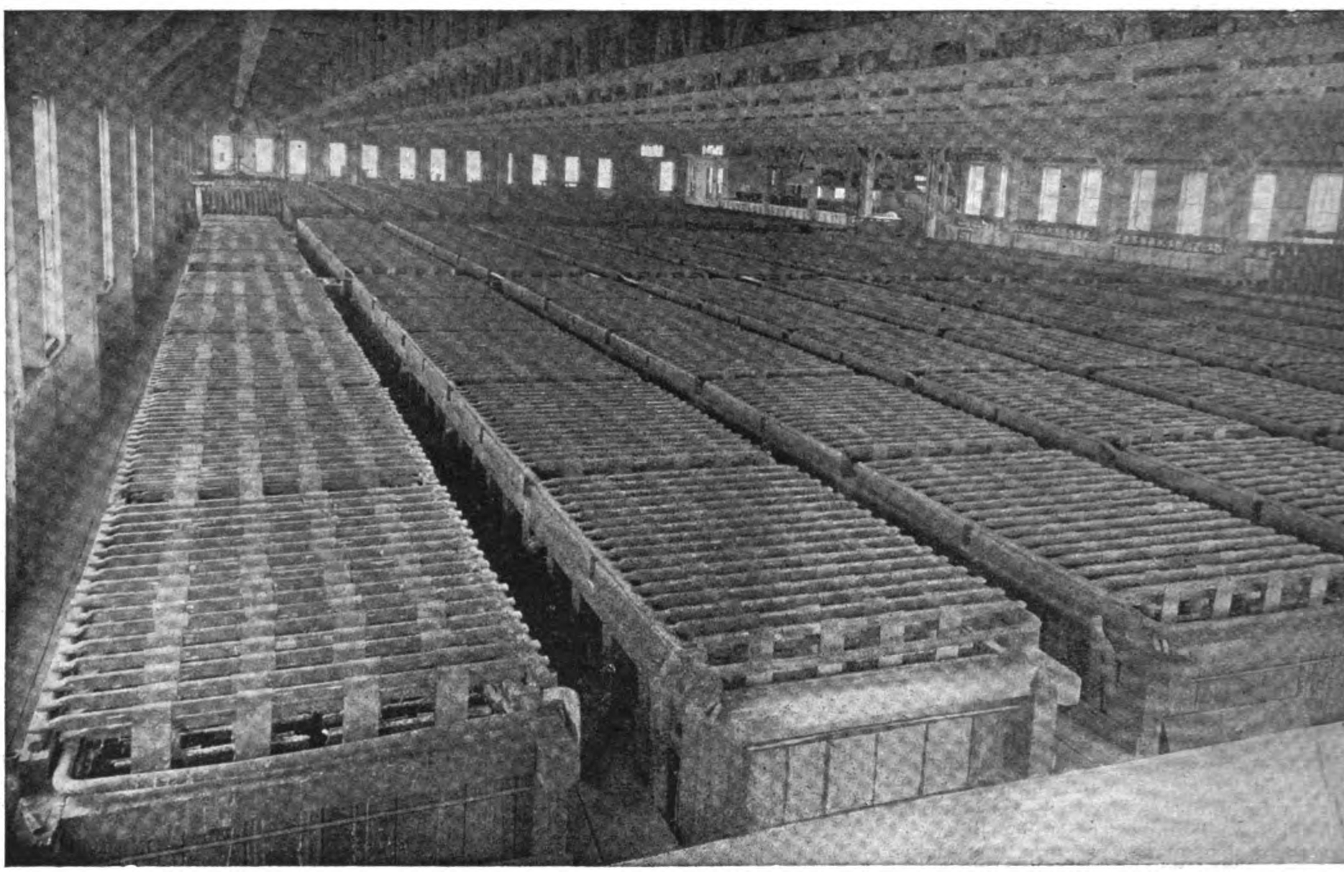
THE considerable quantities of precious metals contained in the copper ores of the Anaconda Mines, Montana, some time ago induced the company owning these famous deposits to install an electrolytic refining plant, the twofold object of which was to secure a pure quality of copper and at the same time to recover the precious metals contained in the ores.

The power house contains Westinghouse engines and dynamos having a capacity of over 2,900 horse-power.

The Refinery Tank House.—The two parts of the refinery are built of wood covered with corrugated iron. Each building covers a space of about 6,500 square yards, and contains 600 electrolytic tanks. Each tank is 2.50 m. long, 1.50 m. wide and 1.00 m. deep. These tanks are built on the self-insulating plan, the air having access to all parts. A wooden framework in the shape of a regular girder is covered on the inside with common planks, and is cut up into compartments by partitions of the same material, 10 of which form a row. Each row of 10 tanks is set on its own foundation, entirely separated from the others and from the working floor. A large air space is between each compartment forming a tank between the working floor and the rows, and all parts of the tanks, at the side as well as below, are of easy access for the air and for the men. Each joint in the woodwork from top of the tanks to the bottom of the foundation is insulated by soaking with insulating material before being put together. The inside of the tanks is lined with lead, and proper protection is provided to preserve it against waste from the copper plates (anodes). On the sides of the tanks the conductors are placed for the electric current, serving at the same time as a support for the electrodes. The bars are of solid copper and are bent in the middle, each reaching over two tanks, being positive on one and negative on the other tank. By means of this bend in the bars all screw connections are avoided between the tanks, leaving only the connections between the different rows to be fixed in the usual way. To support the electrodes flat iron bars are laid across the tanks, resting on the conductors. Copper hooks sustain the plates in the liquid and are hooked on these bars. Ten tanks built together make a row. Ten rows make a set of 100 tanks, and two sets make a system of 200.

As the composition of the crude copper changes in regard to its impurities and as the electrolyte has to be modified according to the amount of such impurities, it is absolutely necessary to be able to separate each system from the others. There are six systems of like capacity of 200 tanks, each being able to turn out about 35 tons of electrolytic copper per 24 hours as a maximum. All the tanks of each system are connected in series for the passage of the electric current produced by one generator. Each row of 10 tanks has its individual supply tank for the circulation of the liquid. The circulation is established by having rows built on an inclined plane. The liquid runs by gravity from one tank to the next until it reaches the last one, from which it falls to the collector. The collector conveys the liquid to the acid pumps, working by air pressure, which deliver it anew to the distributor and from there to the small supply tanks to begin the same course over again.

The three first systems are provided with overhead trolleys, one above each double row, and by means of these the tanks are loaded with copper and also unloaded after it is refined.



Electrolytic Tank Room, Anaconda Copper Refinery.

The full charge of a tank, weighing about four tons of copper, is loaded up and unloaded in one operation.

On the working floor of all the halls runs an electric road of 20-inch gauge, by means of which all material is conveyed from the railroad in the buildings to the tanks, the scales, etc., and back. The locomotives are of Mr. Thofehrn's design, and were built by the General Electric Company. Underneath the tanks runs another 20-inch road, which communicates with the silver mill, and is used to convey nothing but the refinery slimes, which contain, besides the impurities of the crude copper, the gold and silver in large amount.

Operation of the Refinery.—The work which is going on in the refinery, so far as the mechanical part is concerned, is extremely simple. The men take the anodes from the railroad cars, transport them by the tank-load over the scales and place them on a rack. Here the supporting bars and hooks are laid over the anodes, the crane is brought along, picks up the charge, conveys it to the tank it belongs to and lets it down therein, placing at the same time all the plates in the proper position. In the mean time another crew has prepared on a second rack one load of cathodes, hooked on the support-

ing bars and ready for use. These the crane takes up and brings them like the anodes right on the place where they belong. After this the liquid is turned on and as soon as the tank is filled the electric current is started again and the refining work begins.

The crude material upon which the refinery works is blister copper, containing 98 per cent. copper on the average, and the balance in arsenic, antimony, iron, lead, tellurium, selenium, besides about 110 ounces of silver and 1/3 ounce of gold to the ton.

The large number of tanks and the high cost price of labor at Anaconda necessitated a special means of control in this direction. This has been obtained by an automatic device, looking very much like a regular double commutator of a dynamo, to which all tanks are connected by series of five tanks each. A yoke carrying two brushes slides over the different sections of these commutators, making one complete turn in an hour, and these brushes bring into contact the terminals of each series of five tanks to register the voltmeters. In this way all the tanks are controlled once an hour and the readings registered on paper automatically. This enables the man in charge to see at a glance the condition of all the tanks in the refinery.

Copper.—The Anaconda Copper Mining Company's refinery has been running in full since January 1 of this year, and is turning out between 100 and 120 tons of copper daily according to the output of the mines. The balance of the company's product, from 80 to 100 tons, is refined in Baltimore. The total daily production of the Anaconda Company is about 200 tons of copper. The refinery is built in such a way that in case of an emergency it can easily handle the total product of 200 tons daily with the use of additional dynamos only.

In referring to the cost price of refined copper in Anaconda we have to consider the high price of labor, which amounts to nearly $3 on an average per day per man. The cost of fuel so far has been $5.50 per ton, but this expense will be reduced to $2 per ton when Belt coal is used by means of underfed stokers.

Sulphuric acid costs 2.4 cents per pound in Anaconda, while the other supplies cost accordingly. We can say generally that all expenses in Anaconda are more than twice those at Eastern industrial centers. The refining work at Anaconda costs no less than $14 per ton of copper produced, including the saving of gold and silver contained in the anodes.

The average quality of copper produced in these plants is: Conductivity, 98 per cent., Matthiessen standard; tensile strength, 64,000 to 65,000 pounds per square inch; number of twists in 6 inches of No. 12 wire, 80; elongation, 1¼ per cent. All these measurements were taken on hard drawn wire.

Epuration of the Electrolyte.—The anodes are delivered to the refinery containing about 2 per cent. impurities, which, during the process of refining, go partly into the liquid and partly into the slimes. The impurities which go into the electrolyte are partially taken out on each turn of the electrolyte through the tanks. A certain amount of impurities is allowed to stay in the liquid, however, while the epuration process is regulated so as to limit the accumulation of these impurities only. The epuration process used at Anaconda is extremely simple, requires little attention and necessitates the use of air and cheap chemicals only. This method is preferable to the voluminous and bulky old process of crystallizing which is used almost in all Eastern refineries for the epuration of the electrolyte.

Silver and Gold.—The Anaconda Copper Mining Company's refinery produces about 350,000 ounces of silver and about 1,500 ounces of gold per month. This product is delivered to the market in fine bullion. The silver is .999 fine, and the gold .950 fine. The bullion is reduced at a very low expense, the cost being almost nominal. The process for the refining of slimes is as follows: The silver mud (this name is given the slimes) is sent from the refinery in lead-lined tank-cars to the silver mill. Arriving there, it is hoisted up to the screens, where it is washed with water and all chips of copper, etc., are taken out. The clean silver mud is then run out into boiling tanks, where it is freed from its copper contents by boiling with acid and steam. From this first set of boiling tanks the silver mud is passed over a filter on which it is thoroughly washed with water. It is then put into the second set of boiling tanks from which the other impurities, notably arsenic and antimony, are taken out. From here the silver mud is again placed on filters, thoroughly washed with water and dried on large cast iron pans. A consequent melting in the reverberatory furnace reduces the silver mud to ingots ready for the parting kettles. The ingots are then placed in the parting kettles, where they are boiled with sulphuric acid and the silver dissolved, making sulphate of silver, which later on is diluted with water and precipitated by copper plates, thus obtaining pure cement silver. This is thoroughly washed and dried and then melted again into ingots by furnace charges of two tons each. The ingots are now ready for the market and weigh about 1,200 ounces a-piece. They are assayed, stamped, numbered, weighed and shipped as fine bullion of .999 fine.

Thofehrn's New Refining Process.—The density of current generally employed in Thofehrn's refineries for the production of cathodes is about 10 to 20 amperes to the square foot. The product is melted in order to produce ingots or wirebars, according to the demand of the customers. Mr. Thofehrn has devised a process which joins the utmost simplicity with rapid work and good quality of product, being at the same time economical. The process operates as follows: A hollow cylinder about 8 feet long and 3 feet in diameter is immersed in the electrolyte and forms the cathode on which is taken the precipitate of copper with a density of 50 amperes up to 100 amperes per square foot. The anodes in Mr. Thofehrn's tanks are common converter pigs; ingots, shot or scrap, or whatever is at the disposal of the refiner, and white metal containing 75 per cent. to 80 per cent. copper, have all been used satisfactorily. It is an advantage that this copper in its crude market shape can be used without transforming it previously by melting into plates for anodes, and it is a saving of about $3 per ton. The cylinder which is used as a cathode revolves in a tank at slow speed, and the copper that precipitates upon it is in the shape of extremely fine crystals, assuming the form of octagonal needles or hairs, which can only be seen through a powerful microscope. In order to produce a good and dense deposit of copper these microscopic needles or hairs must be interwoven, felted and compressed. This is attained by the action of numerous small jets of electrolyte directed under pressure against the revolving cylinder. While, apparently, to the naked eye no action whatever seems to follow from the jets, the final result is remarkable. The copper deposited is to the full extent of its thickness, thoroughly dense, even after continuous annealing and hammering no foliation whatever can be obtained. The method of directing a stream of fresh electrolyte on the surface of the cathode has another advantage. The whole cylinder is surrounded by the fresh liquid coming from the epuration tanks and no matter how impure the anodes are and how large the amount of impurities in the liquid the cathodes are fully surrounded by clean electrolyte only. After 1-inch thickness of copper is deposited upon the cathode, the precipitate is taken off by opening the cylinder by means of a small hydraulic jack, especially devised for this purpose. The plates of the deposit on the cylinder are not continuous. A small seam is left in the cylinder for the attachment of the hydraulic jack. After opening the plates sufficiently to slide out the cylinder, the latter is placed on a cast iron bed-plate held on one side. A heavy roller is inserted and pulled forward by a hydraulic ram, thus transforming the plate into a flat sheet, having dimensions according to the size of the cylinder used. The plates so produced are ready to go to the rolling mill without previous melting or annealing. In case wirebars are to be produced a full cylinder of copper is deposited on the cathode. This cylinder, after obtaining sufficient thickness, generally 1 inch, is taken off the mandril, placed on a lathe and cut by means of a circular saw into a strip having a width conforming to the demand. As the cylinders are about 8 feet in length and about 3 feet in diameter, the length and weight of these strips are considerable. Generally, the strips produced are 1 inch square in section, and after passing through a roughing die, which cuts away the sharp angles, the strips are directly brought to the regular draw-benches, and can then be drawn down to any desired size without annealing. The quality of the copper produced in this way is higher than that produced in the usual way by melting, etc. The conductivity is generally 100 per cent., Matthiessen standard. The tensile strength is about 75,000 pounds; elongation about 2 per cent.; number of twists in 6 inches of No. 12 wire, about 100. All tests were made on hard-drawn wire. The expense of refining copper by this process is estimated to be about $16 per ton, including all the processes of transforming the crude copper into the finished product, ready for the rolling mill and for the wire-drawing mill.—"The Engineering and Mining Journal."

PERSONAL.

F. G. REW, the Cornell University student who disappeared from Ithaca nearly two years ago and was found last month in Ceylon, where he had gone as an electrician on a French trading steamer, has returned to his home, in Buffalo. He claims that he has no knowledge how he got to this city from Ithaca, and that he "came to himself" on a cattle ship on which he had shipped. His journeyings have completely restored his health, and he will return to college. His disappearance caused a tremendous sensation and murder was long suspected.

NEWS AND NOTES.

A MAGNETIC PLANT.

An account of an interesting plant which has the apparent property of turning its leaves in a north and south direction, thus behaving like the needle of a compass, is given in "Garden and Forest." Mr. E. J. Hill, of Chicago, who seems to have been investigating it, gives the name of the plant as Silphium lacinatum, and says that the Silphium terebintnlnaceum is affected in the same way, 75 per cent. of the latter orienting themselves in the manner mentioned above. The tendency to orientation seems to be a function of the ages of the leaves in question, the younger ones being said to point more accurately north and south than those of greater age, the latter falling off and therefore supplying an insufficient amount of evidence. It is mentioned that Sir Joseph Hooker remarked the uses which might be made of the peculiarity of this plant; it is stated, also, that he was able when traveling to note perfectly the change in direction of the train by observing the general appearance of these plants which were scattered over the plain.

"ELECTRICITY IS LIFE."

Mr. Robert Hilliard has brought out a new farce called "The Mummy," and based on the idea that the mummy of Rameses II. is brought to life by a bright Chicago girl who playfully attaches a galvanic battery to his remains. It is well known that electricity has a vitalizing effect when thus used.

COPPER PRODUCTION AND WAGES.

As offsetting the delusion that gold has advanced in value and that wages are, therefore, lower, and would be raised by calling one silver dollar two, the "Iron Age" prints the records from the Quincy Mining Company, in the Lake Superior copper region. In the period of thirty years the price of copper has been cut in halves, but the wages of the men have risen 25 per cent., although the purchasing capacity of the money is far more than it was. Owing to the introduction of power drills, explosives, etc., the efficiency of the labor has been tripled. The "Iron Age" says that corresponding figures apply all along the line of hoisting, crushing, washing and refining the copper.

TORPEDOES FOR BODY SNATCHERS.

If one may judge from the patent records, live people do a good deal of thinking about death. The very latest device that has been applied to burial appliances is the "coffin torpedo," which is designed as an effective and very summary punishment for body snatchers. Nothing less than a bomb is introduced into the coffin, before the latter is closed, the arrangement being such—we spare the reader all technical details—that any attempt to force it open will release a spring, strike a percussion cap, and set off the bomb. The thing is done, and the robber is floating in pieces about the air long before he has had any time to prepare for his sudden journey.

But what happens to the corpse? The inventor leaves us in the dark on this point—probably because the question is hard to answer. We are afraid the coffin torpedo has no very brilliant future on this account, and for the further reason that local authorities (who are notoriously difficult to deal with) might object to have their burial grounds studded with infernal machines.

A device much more reasonable is the "grave annunciator," for use in the case of burial alive. Any disturbance in the coffin closes an electric circuit, and springs an alarm in the house of the superintendent, who takes note of the number of the grave, and proceeds without further delay to dig up the victim. For the benefit of those whose relatives have been cremated, another inventor has patented a process for converting the ashes of the defunct by the aid of silicate of soda, into paste, which is to be moulded into a bust or statuette.—"Tid-Bits."

WHAT CAMMACK THINKS.

It appears that Mr. Cammack has made a careful investigation of the financial prospects of the General Electric Company and has satisfied himself that the stock will soon be placed on a dividend-paying basis after the capital has been reduced to $15,000,000.—"Boston Advertiser."

THE CREWE HOSPITAL, in England, finds that by using the electric light, the number of beds in the wards can be increased from twenty-eight to forty-five, as the incandescents do not vitiate the air like gas jets, and hence each patient requires fewer cubic feet of space.

ELECTRIC POWER FOR CALAVERAS COUNTY, CAL.

The California Exploration Company has agreed to take 1,500 horse-power of the electric energy to be developed in the Blue Lakes enterprise, employing it in the development of its mining ventures in Calaveras County. The Blue Lakes people are busy at the present time perfecting plans, specifications and details for the work, and considering the matter of contracts for electrical and other supplies. They have more than $100,000 to put into the plant, and have determined to put in the most efficient that money can secure, and of sufficient capacity to generate 6,500 horse-power at the point of delivery. They estimate that that amount will be all that is necessary for some time, and, in fact, may not put in quite that capacity to begin with, but will construct their buildings, foundations, pipe lines and ditches for machinery to develop that amount of power. The electric generating plant will be located at the Keirsing mill site, a little above Big Bar, in Calaveras County, and the water to operate it will be taken from the Blue Lakes ditch, near Madden's tunnel, and carried part way through the old Butte ditch, which will have to be enlarged and repaired, and part of the way through pipe. This summary gives a maximum amount of power with a minimum amount of water. The company has only about eight months to complete its contract.

PUMPING OIL BY ELECTRICITY.

An experiment in pumping oil wells by electricity was made recently on the property of Mr. J. Menisinger, at Lima, O. The current was taken from the street railway circuit at 500 volts and a Triumph 5 horse-power motor was used. The outfit worked well and gave much ground for encouragement, but the uneven supply of current made the operation of the plant unreliable. What is needed is a special plant, or a regular power service.

NOTES.

ELECTRIC TROLLEY BOATS are proposed for the River Spree, near Berlin, for the purpose of towing barges.

SAVING THE FORESTS.—It is pointed out that the use of electric power in the mining regions and timber belts of the far West, where coal had been costly and difficult to obtain, is doing much to conserve the forests, whose denudation was becoming a serious evil.

STUDYING TERRESTRIAL MAGNETISM.—An observatory for terrestrial magnetism has been established in connection with the astronomical observatory in Munich, and Dr. Franz von Schwarz has been made director.

OBITUARY.

MRS. H. C. C. OVERBURY.

The sad news comes from Niagara Falls of the death in that city of Mrs. Helen Cary Condit Overbury, wife of Mr. Frederick Overbury, manager of the new plant of the Chemical Construction Company, recently described in these columns. Mrs. Overbury's death occurred shortly after noon on Wednesday, September 23, at the family home on Eleventh street. She was but twenty-two years old, and her death following so soon after they had taken up their residence at Niagara is especially sad. While living at the Falls Mrs. Overbury made many friends, who sorrow at her early death. The remains were taken to Boonton, N. J., for interment.

DAVID C. SPRAGUE.

We regret to record the death of David C. Sprague, the father of Frank J. Sprague. He was killed in Rahway, N. J., where he lived, about nine o'clock on Thursday morning, Sept. 24, by a fast freight train on the Pennsylvania Railroad, near the Poplar street crossing. He attempted to cross the track, evidently not hearing the rapidly approaching train, and was hurled against the flaghouse.

David Cummings Sprague was born in New England about sixty-three years ago and was a member of one of the oldest families of that part of the country. He lived for years at Milford, Conn., until his wife died, thirty years ago. Afterwards he went to Colorado and spent twenty years in mining regions of that and other Western States. Later he represented the Sprague Electric Railway and Motor Company in Buenos Ayres. At the time of his death he was the manager of the Eustis Manufacturing Company, at Rahway. He leaves two sons, Frank J., president of the Sprague Electric Elevator Company, and Charles M. Sprague, treasurer of that company.

MRS. F. R. COLVIN.

We regret to note the death, Sept. 28, in this city, of Mrs. F. R. Colvin.

Synopsis of Current Electrical Literature.

EDITED BY MAX OSTERBERG, E. E.

Alternating Currents:

LEAD OR LAG?—By W. G. Rhodes, M. Sc. Capacity causing a displacement of phase between the e. m. f. and current, the question arises does it cause a lead or lag. Author finds by mathematical reasoning that, if we call the displacement of phase of current over e. m. f. due to self-induction, a lag, we are driven to calling that due to capacity a lead.—Lond. "Elec. Rev.," Sept. 4, '96.

Central Stations:

CLEVELAND ELECTRIC ILLUMINATING COMPANY.—Illustrated description of the station which consists in the main of four vertical boilers, three of which are rated at 800 h. p. each, and one at 500 h. p. They work under 200 pounds of pressure. Three engines are installed, capable of developing 750 h. p. each, and these are connected by shafting to the various generators.—"Elec. World," Sept. 5, '96.

Dynamos and Motors:

ON THE SEAT OF ELECTRO DYNAMIC FORCE IN IRONCLAD ARMATURES.—By Townsend Wolcott. A discussion of the paper on the same subject by Houston and Kennelly, printed July 4, '96.—"Elec. World," Sept. 5, '96.

LOAD LOSSES PRODUCED BY ARMATURE CURRENTS.—By Harris J. Ryan. Referring to Mr. Blathy's load losses, Prof. Ryan mentions that in making the tests on the World's Fair dynamos, he, in conjunction with Dr. C. E. Emery, observed similar effects; he is also of the opinion that most dynamo manufacturers are aware of the armature lag.—"Elec: World," Sept. 5, '96.

COMBINED ALTERNATING AND CONTINUOUS CURRENT DYNAMOS.—A combined system in one machine has had a trial at Woolwich, where the distribution is accomplished by alternating current at ordinary pressures and the transmission at 2,000 volts alternating current. The alternator feeds into the transmission mains, while the dynamo feeds into the storage battery. By running the dynamo as a motor from the batteries and assisting the engines, the alternator's output can be nearly doubled.—Lond. "Elec. Rev.," Sept. 4, '96.

ABSOLUTE STANDARDS OF SELF INDUCTION.—By Max Wien. Description of coil, which author guarantees to be made close enough to warrant its correctness within one per cent.—"Wiedemann's Ann.," p. 553, vol. 58, Abstracted in ""Elektrotechn. Zeitschr.," Aug. 20, '96.

Electro-Chemistry:

DRAWING AND ROLLING ALUMINUM.—F. L. Rawson of the Industrial Inventions Development Company, England, announces that a new process for drawing and rolling aluminum is being introduced. Aluminum can, up to the present time, only be cast. (?) This notice appeared in "Industries and Iron," Aug. 28, '96.

NOTES ON THE ELECTROLYTIC DETERMINATION OF IRON, NICKEL AND ZINC.—By H. H. Nicholson and S. Avery. Several tables giving the current, time, weight, etc., of the solutions. From "Ztschr. anorg. Chem." in Lond., "Industries and Iron," Aug. 28, '96.

PROCESS FOR ELECTROLYTIC DESILVERING ARGENTIFEROUS LEAD.—By D. Tommasi. The principle on which this procedure is founded consists in electrolyzing a lead solution, which not merely possesses an extremely weak electric resistance, but does not give rise to lead peroxide (PbO_2), and, in taking the argentiferous alloy itself as anode and cathode, a metallic disc which cannot be attacked by the bath.—"Eng'ing and Min. Journ.," Aug. 29, '96.

THE DUMOULIN COPPER DEPOSITING PROCESS.—A process of some possible potential importance is being experimented with in England for the purpose of depositing copper electrolytically, in the form of sheets and tubes, direct from the matte or precipitate. The essence of the invention is the special method for rendering the arrangement of the deposited molecules perfectly homogeneous, and thus obtaining uniform strength in the tube as it is formed on the revolving mandrel.—"Eng'ing and Min. Journ.," Aug. 29, '96.

A CONTRIBUTION TO THE HISTORY OF THE ELECTROLYSIS OF ALKALINE CHLORIDES.—By Geo. Lurege, Ph. D. An attack on Mr. Andreoli's work "Electrolysis of Chlorides," in which the author shows that Andreoli has not sufficiently credited the German and French patentees with priority patents. "Eng'ing and Min. Journ.," Sept. 5, '96.

DILUTION LAW OF ELECTROLYTES.—By L. Storch. Author has discovered a new law of conductivity for infinite solutions. (An infinite dilution is that at which the electrolyte has the greatest conductivity.)—"Zeitschr. f. Physik. Chemie.," Vol. XIX., p. 13, '96. Abstr. in Lond. "Elec. Rev.," Sept. 4, '96.

APPLICATION OF ELECTROLYSIS IN THE MANUFACTURE OF BEET SUGAR.—By G. Ehrlich. A description of the Schollmeyer methods of purifying the sugar with several numerical examples taken from reports of actual experiments.—"Elektrochem. Zeitschr.," Sept., '96.

Electro-Physics:

STATIC CHARGE OF ELECTRICITY UPON THE SURFACE TENSION OF WATER.—By E. L. Nichols and J. S. Clark. Experiments are described upon the size of the drop delivered by a water dropper at different electric potentials. The object of the paper is to obtain direct evidence of the electric charge upon the surface tension.—Abstracted in "Electrical World," Sept. 5, '96.

Isolated Plants:

ELECTRICITY IN SHIPS.—By F. Eickenrodt. Paper read before the Institution of Naval Architects, June 13, '96. Author treats the subject from the shipbuilder's point of view and finds many inherent advantages in the use of electric motors for all possible purposes, principally on account of cleanliness, space saved, and simplicity of management.—"Elektrotechn. Anzeiger," Aug. 23, '96.

CONNECTING INCANDESCENCE LAMPS IN SERIES ON ALTERNATING CURRENTS.—A study of the connections in series on reaction coils and on little individual transformers.—Lond. "Elec. Rev.," Sept. 4, '96.

Lighting:

ELECTRIC LIGHTING IN BELFAST.—Some illustrations to accompany the paper, by V. A. H. McCowen, previously referred to, showing curves of gas consumption, plotted from the results of tests on a tandem and on a single gas engine. They show the total consumption per hour, per indicated horse-power hour, per electrical horse-power hour, and also the percentage of efficiency, or ratio of electricity to indicated horse-power.—Lond. "Elec. Eng'r," Aug. 28, '96.

CONSUMPTION OF ELECTRIC ENERGY IN INCANDESCENCE LAMPS IN REFERENCE TO THE NEW TARIFF.—By Francesco Personali. Exhaustive experiments made in a large factory determining the exact amount of energy consumed by the lamps in comparison with their candle power.—"Lond. Elec. Rev.," Aug. 28, '96.

Magnetism:

MAGNETIZATION AND HYSTERESIS OF SEVERAL QUALITIES OF IRON AND STEEL.—By H. du Bois and E. Taylor Jones. A thorough investigation of eight distinct qualities, materials of different hardness. No chemical analyses are given, but all materials are such as can be procured in the market.—"Elektrotechn. Zeitschr.," Aug. 27, '96.

MAGNETIC RESEARCHES OF THE PHYSIKALISCH TECHN. REICHSANSTALT.—By Dr. A. Ebeling. Review of the methods employed to do the most accurate work.—"Elektrotechn. Zeitschr.," Aug. 20, '96.

SECULAR VARIATION OF TERRESTRIAL MAGNETISM.—By L. A. Bauer. Paper read before the Am. Assoc. for the Advancem. of Science. That part of the earth's permanent magnetism which is symmetrical about the earth's rotation axis is separated from that which is unsymmetrical.—Abstract in "Elec. World," Sept. 5, '96.

MAGN. & HYST. of CERT. KINDS OF IRON & STEEL.—By Du Bois & James. Add.—Lond. "Elec. Rev.," Sept. 4, '96.

Mechanical:

THE OLIN GAS ENGINE.—This engine is designed to work principally in the oil regions and is claimed to run on 10-15 cubic feet of gas or gasoline vapor per h. p. hr.—"Am. Manuf.," Sept. 4, '96.

WESTINGHOUSE GAS ENGINE.—An illustrated description.—See "Iron Trade Rev.," Sept. 3, '96.

Miscellaneous:

A NEW POLE LIGHTNING ARRESTER.—By J. Berliner. This consists of a porcelain double petticoat on which a metallic ring is fastened. The discharge takes place through a great many small metallic teeth.—"Elektrotechn. Anz.," Aug. 27, '96.

METHODS OF CHARGING FOR ELECTRIC ENERGY.—By L. Andrews. Two different systems of charging for electric energy exist in Brighton and Hastings. Author presents curves showing the ratio of the quarterly expenditure to the quarterly receipts under the two systems.—Lond., "Lightning," Sept. 3, '96.

POSTMASTER GENERAL'S REPORT.—An abstract of an English report showing the results for the year ending March 31, '96. A total of 78,839,610 telegrams, an increase of 10.12 per cent. over the previous year, were sent.— "Lond. Elec. Eng'r.," Aug. 28, '96.

SOCIETE INTERNATIONALE DES ELECTRICIENS "SCHOOL OF APPLICATION."—A prospectus of the school. —"Lond. Elec. Rev.," Aug. 28, '96.

Railways:

HARTLEPOOL ELECTRIC TRAMWAYS.—Length of line, 2½ miles. Boilers working at 140 pounds pressure evaporate 3,400 pounds of water per hour. Two Willans engines of 100 indicated horse-power with 450 revolutions supply the power for two direct coupled 500 volts and 120 amperes dynamos Details of plant with illustrations in Lond. "Lightning," Aug. 27, '96.

Roentgen Rays:

PRESCRIPTION FOR A FLUOROSCOPE.—To two parts of tungstate of sodium is added one part of calcium chloride, and the mixture is fused to a red heat. A resulting compound of calcium tungstate and sodium chloride is formed, which latter salt exerts active hygroscopic properties, and, as a result renders the calcium tungstate quite negative to the X-rays. The fused mass, however, is immersed in water for forty-eight hours, when the salt is dissolved out, leaving the insoluble calcium tungstate as a precipitate. This is separated by filtration, and, when dry, assumes a crystallized form and is very sensitive to the X-rays. This is spread evenly over the screen, a matter at first of some difficulty, but one easily overcome with a little practice. Copied from The Electrical Engineer in Lond. "Industries and Iron," Aug. 28, '96.

REGULATION OF VACUUM IN CROOKES' TUBES.—By Ralph McNeill. In a letter the author remarks that by reversing the current in a tube for some time the vacuum may be sufficiently weakened to produce the proper X-ray effect, thus making the re-exhausting unnecessary.—"Scient. Amer.,"

SOME EXPERIMENTS WITH CHEMICALS.—By Sehrwald. Author finds that halogens are quite opaque to the rays. "Deutsche med. Wochenschr." and in abstract in "Elektrochem. Zeitschr.," Sept., '96.

X-RAY SCREENS.—By Charles Henry. Author uses a screen of phosphorescent sulphide of zinc, covered with a sheet of stiff paper and lays the object to be photographed upon the paper. The impression of light and darkness remains on the screen for fifteen minutes and even longer if slightly heated.—"Comptes Rendus." Aug. 24, '96, Abstract in Lond. "Elec." Sept. 4, '96.

PART PLAYED BY THE DIELECTRIC IN THE DISCHARGE BY ROENTGEN RAYS.—By Jean Perrin. A series of interesting discharge experiments.—"Comptes Rendus," Vol. 123, No. 6, p. 351. Lond. "Elec.," Sept. 4, '96.

ON THE ELECTRIC CONVECTION ALONG THE LINES OF FORCE CAUSED BY ROENTGEN RAYS.—By Prof. Righi. Experiments tending to show that the action of X-rays results in convection movements along the lines of force of an electric field.—"Comptes Rendus," Aug. 24, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 22, 1896.

Alarms and Signals:—

ELECTRIC SIGNALING DEVICE. G. F. Knollmann, Evansville, Ind., 567,984. Filed Aug. 7, 1896.
Means of signaling between locomotives traveling on the same tracks.

SIGNAL FOR CABLE RAILROADS. M. Norden, New York, 568,205. Filed June 29, 1896.
An electrically actuated device for detecting broken strands in the cable.

Batteries:—

PROCESS OF TRANSFORMING CHEMICAL ENERGY OF FUEL INTO ELECTRICAL ENERGY. W. Borchers, Duisburg, Germany, 567,959. Filed Nov. 21, 1894.
Consists in placing a bath of cuprous chlorid in a closed circuit and dissolving fuel gas in it at one point and oxygen of the air at another point.

ELECTRIC BATTERY. H. C. Thomson, Boston, Mass., 568,007. Filed June 25, 1896.
Contains a carbon element and a zinc element which are held separated without the use of rubber rings.

ELECTRODE. H. Blackman, New York, 568,229. Filed Feb. 9, 1895.
Consists of a dense impermeable mass of combined electroconductive iron oxid and a flux capable of acting to promote the fusion of the oxid.

ELECTRODE FOR ELECTROLYTIC DECOMPOSITION. H. Blackman, New York, 568,230. Filed May 9, 1895.
Similar to above.

ELECTROLYTIC ANODE AND APPARATUS. H. Blackman, New York, 568, 231. Filed May 31, 1895.
Similar to above.

Conductors, Conduits and Insulators;—

INSULATOR. W. Wood, Middlebury, Conn., 568,060. Filed March 11, 1896.
Consists of two tubular parts placed one within the other, both provided with an oblong slot which communicates with the central bore.

METHOD OF MAKING UNDERGROUND CONDUCTORS. J. H. Croskey and J. Locke, Pittsburg, Pa., 568,298. Filed May 21, 1896.
A section of conduit comprising a cover and a lining of glass molded into the casting and around a core sustained therein.

Electro-Metallurgy:—

ELECTROLYTIC APPARATUS FOR EXTRACTING GOLD AND SILVER FROM THEIR ORES. L. Pelatan, Paris, France, and F. Clerici, Milan, Italy, 568,099. Filed Oct. 1, 1895.
Comprises a vat, a mercury cathode upon the flat bottom thereof, an endless belt anode, a portion of which is in parallelism with the bottom of the tank and means for moving the anode continuously in one direction.

Lamps and Appurtenances:—

APPARATUS FOR MANUFACTURING INCANDESCENT ELECTRIC LAMPS. G. R. Lean and J. R. Massey, Cleveland, O., 568,142. Filed Dec. 21, 1895.
A machine comprising a bulb-holder, means for forming a hole in the enlarged end of the bulb, and devices for welding a tube to the bulb so as to communicate with the hole.

MATERIALS AND PROCESS FOR INCANDESCING MANTLES. William L. Voelker, Elizabeth, N. J., 568,184. Filed May 19, 1896.
Consists in mixing together the oxids of magnesium and calcium and then electrically heating them to a very high temperature.

ELECTRIC LAMP FOR VELOCIPEDES, ETC. A. M. Rodriguez, Brooklyn, N. Y., 568,209. Filed Dec. 20, 1894.
A small dynamo is driven from a wheel of the velocipede and feeds an incandescent lamp.

COMBINED GLOBE-HOLDER AND ASH-PAN. T. E. Adams, Cleveland, O., 568,223. Filed April 6, 1895.
The combination in an electric arc lamp with the carbons and a globe-holder, of a rod secured to the globe-holder independently of the holders of the carbons, the rod being so disposed as to receive heat from the arc and conduct it to the globe-holder.

INCANDESCENT LAMP. J. T. Lister, Cleveland, O., 568,262. Filed April 25, 1896.
Employs two pairs of filaments inserted at opposite ends of the bulb.

Miscellaneous:—

ELECTRIC HAND LIGHTING GAS BURNER. G. J. Galbraith, Boston, Mass., 567,971. Filed June 25, 1896.
The movement of the thumb piece serves to oscillate the three-gas valve and also to vibrate an electrode at the top of an elongated gas pillar.

ELECTRICALLY HEATED SMOOTHING SURFACE. W. S. Hadaway, Jr., 567,976. Filed March 24, 1896.
A coil of wire placed within the smoothing cylinder and clamped therein.

MULTIPLE CIRCUIT CLOSER FOR ELECTRIC TRAP PULLING Devices. T. R. Barney, San Francisco, Cal., 568,013. Filed April 21, 1896.
Details of construction.

THERAPEUTIC ELECTRODE. J. S. Muir, Stockton, Cal., 568,095. Filed April 17, 1896.
Consists of a flexible backing of non-conducting material, a flexible sheet of electro-conducting material, upon the face of the backing and a layer of pliable substance of conducting character upon the face of the conducting sheet.

APPARATUS FOR PRODUCING OZONE. N. Tesla, New York, 568,177. Filed June 17, 1896.
Means for charging a condenser, a circuit of low self-induction into which the condenser discharges, a coil for raising the potential of such discharge, and means for passing a current of air through the high potential discharge.

APPARATUS FOR PRODUCING ELECTRIC CURRENTS OF HIGH FREQUENCY AND POTENTIAL. N. Tesla, New York, 568,176. Filed April 22, 1896.
Comprises a circuit of high self-induction and means for making and breaking the same, a condenser around the point of interruption in the circuit, and a transformer the primary of which is in the condenser circuit.

METHOD OF AND APPARATUS FOR PRODUCING CURRENTS OF HIGH FREQUENCY. N. Tesla, New York, 568,179. Filed July 6, 1896.
Consists in generating an alternating current, charging a condenser thereby during determinate intervals of each wave thereof and discharging the condenser through a circuit of low self-induction.

APPARATUS FOR PRODUCING ELECTRICAL CURRENTS OF HIGH FREQUENCY. N. Tesla, New York, 568,180. Filed July 9, 1896.
Similar to above.

ELECTRIC SIGN. M. Norden, New York, 568,204. Filed Feb. 28, 1896.
Details of construction.

PROCESS OF AND APPARATUS FOR DISTILLING FATTY SUBSTANCES. V. J. Kuess, Bordeaux, France, 568,258. Filed April 6, 1895.
Consists in passing an electric current through the substances and simultaneously injecting into the same a current of steam which is decomposed by the electricity and acts as a conductor for it through the mass.

Railways and Appliances:—

TROLLEY AND TROLLEY SUPPORT FOR ELECTRIC CARS. W. Grunow, Jr., 567,975. Filed Sept. 23, 1895.
Adapted for conduit use.

ELECTRIC BRAKE. A. F. Macdonald, Schenectady, N. Y., 567,-989. Filed April 18, 1896.
Alternates the machines used as current generators in a four-motor equipment.

APPARATUS FOR CONTROLLING ELECTRIC MOTORS. H. W. Leonard, East Orange, N. J., 568,088. Filed April 30, 1896.
Comprises a rheostat, a line switch closed thereby, and means for automatically opening switch independently of the movement of the rheostat contact lever when the energy in the circuit exceeds a certain amount.

ELECTRIC CAR HEATER. J. G. Noyes, Milford, Conn., 568,168. Filed April 8, 1896.
The heating portion is removable.

APPARATUS FOR GENERATING ELECTRICITY FOR LIGHTING OR HEATING RAILROAD CARS. C. E. Dressler, New York, N. Y., 568,193. Filed May 2, 1894.
The dynamo is driven by a blower operated by a motor on the car axle.

Regulation:

AUTOMATIC DEVICE FOR ELECTRIC CURRENT REGULATION. E. W. G. C. Hoffman, Charlottenburg, Germany, 567,982. Filed April 17, 1896.
Comprises a relay provided with auxiliary coils, respectively, to assist and oppose the main relay coil, and a circuit controlling device adapted to connect one or the other of the coils in circuit.

METHOD OF REGULATING APPARATUS FOR PRODUCING CURRENTS OF HIGH FREQUENCY. N. Tesla, New York, 568,-178. Filed June 20, 1896.
Consists in varying the frequency of the impulses of current from the supply circuit.

Telephones:—

TELEGRAPH INSTRUMENT. O. M. Runkle, Columbus, O., 568,-103. Filed June 2, 1896.
A key having its working parts inclosed.

Telephones:

SUBSTANCE FOR TELEPHONE ELECTRODES. D. Drawbaugh, Eberly's Mill, Pa., 567,966. Filed Jan. 10, 1896.
Composed of granular platinum having its surface covered with a reduced silver salt.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PERKINS HEAT REGULATING SWITCH.

NOW that the fall and winter seasons are upon us, street railway managers who have an eye to the comfort of their patrons are looking sharply after their car-heating appliances. Among the latter, of importance second only to that of the electric heater itself, is the heat-regulating switch—for it is evident that passengers may be as much oppressed by a superabundance of heat as they may be made to suffer from lack of it. A good heat-regulating switch is, therefore, an essential part of the heating outfit and to fully meet the demands of such a device the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., have brought out the switch illustrated in the accompanying engraving.

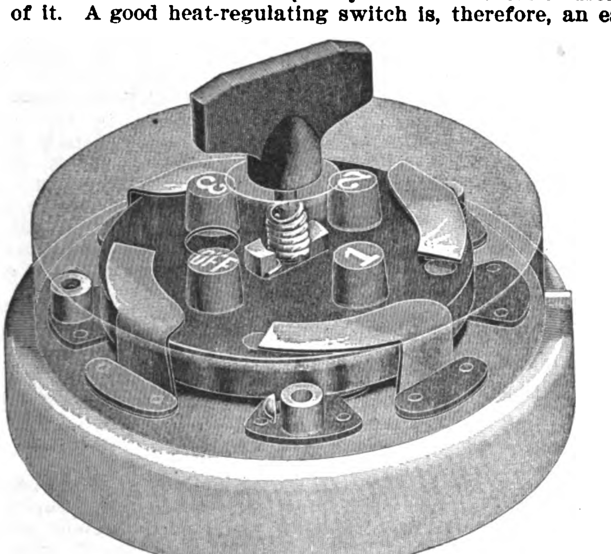


FIG. 1.—THE PERKINS HEAT REGULATING CAR SWITCH.

This switch is a modification of the well known Gibbs switch, manufactured by the same company. The handle, upon being turned from left to right, raises, by means of a screw thread cut thereon, a nut, loose in the insulating block, which is then carried forward, as soon as released from a lock in the base, with great rapidity, and, after a quarter revolution, drops again into a lock, where it is firmly held. The parts revolve in one direction only.

A feature of this switch consists in the loose contact pins, allowing automatic adjustment between the points, so that when "made," contact is assured with every point by the pressure of strong spring copper brushes upon one end of the pin, forcing the other against the adjoining contact plates. When in contact, the insulating block is free to move slightly in any direction, and cannot bind the contact pins.

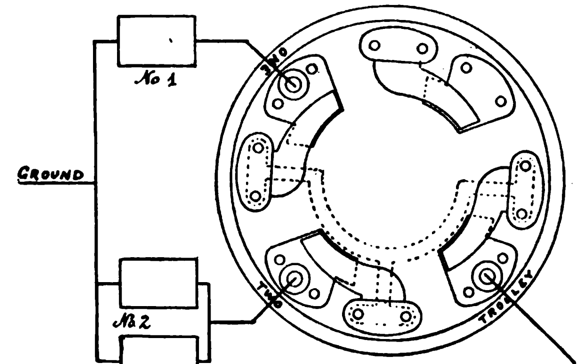


FIG. 2.—THE PERKINS HEAT REGULATING CAR SWITCH.

Another valuable feature of this switch consists in the four simultaneous breaks of the circuit, each time the switch is turned from one position to the next, thus reducing the sparking to a minimum.

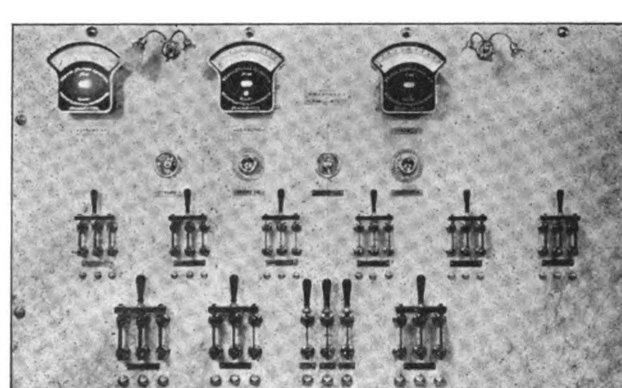
The heat-regulating switch is used for the regulation of heat by different combinations of the heaters. The diagram of connections is shown in Fig. 2. On the commutator are four raised bosses or dials, on which are printed "OFF," "1," "2," "3," respectively. These dials appear successively before a hole in the cover, and thus indicate the position of contacts in the commutator.

From the "off" position, as indicated by dial, the first quarter turn connects in circuit the heaters No. 1, and the figure 1 appears on the dial. The second turn throws out of circuit heaters No. 1 and connects in circuit heaters No. 2, and the figure 2 appears on dial. The third turn connects heaters No. 1 and No. 2 in parallel, which gives the maximum amount of heat and the figure 3 appears on the dial.

The switch is well made in all its parts, and is capable of taking 15 amperes at 500 volts, having a quadruple break.

BALL SWITCHBOARD WORK.

WE illustrate in the accompanying engraving the Italian marble switchboard lately installed at James McCreery & Co.'s dry goods house on West Twenty-third street, New York City, by the H. P. Ball Manufacturing Company, No. 101 Beekman street, New York, for Messrs. H. B. Coho & Co. This switchboard is 10 feet long and stands 7 feet high. Only the switches appear on the face of the board, as the lugs, bus-bars, connections, and fuses are placed behind the board.



MODEL SWITCHBOARD FOR SMALL PLANT.

A novelty in this board which at the same time lends an artistic appearance to the switches, is the type of switch which has been brought out exclusively for switchboard work by the H. P. Ball Manufacturing Company. These switches have

round bases holding the clips, instead of square, as they have heretofore been. This round base is handsomely turned, polished and lacquered and the clips are finished down to this form by hand, which gives the completed article a very handsome appearance.

The switchboard controls 2 50-kilowatt Eddy generators, direct connected to two Ideal engines. The instruments are the Weston illuminated dial pattern. A voltmeter switch is arranged to measure not only the voltage of the individual generators but also the potential between the various circuits and the ground. The H. P. Ball Manufacturing Company have been very much complimented on this installation.

NEW CONTRACTS OF THE ST. LOUIS IRON AND MACHINE WORKS.

The St. Louis Iron and Machine Works have just completed the steam plant for the Maryville, Mo., Electric Light and Power Company, and the new plant is now furnishing lights for the entire city. The equipment consists of a boiler plant of 250 horse-power capacity, a St. Louis Corliss engine of 250 horse-power capacity, a Thomson-Houston arc dynamo of 40 light capacity, a 50 kilowatt, General Electric alternating dynamo, and a 75 kilowatt Fort Wayne alternating dynamo.

The St. Louis Iron and Machine Works are also furnishing the new power plant for the Trenton, Mo., Thomson-Houston Electric Light and Power Company, and will install a St. Louis Corliss engine of 125 horse-power capacity, with line shafting, belting, etc. When the new machinery is installed and in operation, the old plant will be abandoned. New dynamos will be purchased.

The St. Louis Iron and Machine Works are furnishing the entire steam plant for the new lighting station of the Bement. Ill., Electric Light and Power Company. This will consist of two horizontal steel boilers, one St. Louis Corliss engine of 125 horse-power capacity, line shafting and belting.

NECKTIE ELECTRIC LIGHT.

The Ohio Electric Works, Cleveland, Ohio, have just placed on the market an electric light for neckties that is novel and useful. It consists of a candle-power lamp with two small pocket batteries connected, and by pressing a button a light sufficient to read by is given. It is being used on the stage by minstrels and actors, and also by the police and watchmen. It is not a toy, but a useful little electric light apparatus. The price is $3 for the complete outfit, and a liberal discount is allowed to the trade. A complete sample will be forwarded for $1.50, on application.

STEAM MOTOR MACHINE STOKERS.

The American Stoker Company, of Dayton, Ohio, has recently perfected a steam motor which is applied to each stoker, thus making each machine independent. This renders the work of installation very simple. It also renders the stoker practicable for use under marine boilers.

This company is desirous of a general representation through engineering firms handling pumps, heaters and boiler room supplies, and invites correspondence from interested parties.

THE WIRT DYNAMO BRUSH.

We have received an advance copy of an interesting circular describing the new Wirt dynamo brush, manufactured by Mr. Charles Wirt, of 1028 Filbert street, Philadelphia.

In this new brush Mr. Wirt employs his well known sandwich arrangement, but the materials employed have been changed. The conducting part of the brush consists of pure leaf copper, hard rolled, which is placed in the middle. On either side of this is placed a layer of high resistance metal, very thin and with a certain amount of spring temper. Then follows again on either side a layer of antifriction foil, the amount of which is varied with the nature of the service. This adds to the smoothness of running and reduces frictional wear. Outside of all come the stiffening strips of copper providing a low resistance circuit to the brush holder. These latter strips do not reach the commutator and have no part in the current collection.

The new type of Wirt dynamo brush is non-sparking and flexible, and all interested should write for the circular in which Mr. Wirt describes very clearly the rationale of its construction.

READY REFERENCE FOR ENGINEERS AND STEAM USERS.

There are a thousand and one questions constantly arising in the use of steam in engines and boilers, the answer to which cannot be carried around in one's head. Messrs. Houston, Stanwood & Gamble, engine builders, of Cincinnati, have just issued a new edition of their "Ready Reference for Engineers and Steam Users," by Mr. J. B. Stanwood, M. E., in which these questions are answered in a clear and understandable way. The many practicable hints on the design and construction of engines and boilers will be of special use to intending purchasers, embodying as they do the experience of many years.

Messrs. Houston, Stanwood & Gamble have also issued a new catalogue of their slide valve engines and tubular boilers, which is excellently illustrated and contains much useful information. Both the "Ready Reference" and Catalogue can be had free on application.

THE WILLARD STORAGE BATTERY.

We have received from the Willard Electric & Battery Company, of Cleveland, Ohio, their new catalogue, containing a list of the sizes and capacities of all the types of cells made by them for various purposes. These cells are built in sizes varying from the small pocket cell to the heavy central station accumulator. The Willard automatic switch is also described and illustrated. A valuable addition is the "Directions for Charging Storage Batteries," from continuous current, as well as in connection with alternating circuits, which will prove very useful in the hands of battery users.

ADVERTISERS' HINTS.

THE WHEELER REFLECTOR COMPANY illustrate one style of their reflectors. They claim to be the largest manufacturers of these goods in the world, for every conceivable use.

THE E. G. BERNARD COMPANY are advertising their dynamos and motors in which the magnetic field is made of one piece of forged iron. This type of machine has been shown to possess many advantages over other makes and they say their cost is moderate.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY carry a stock of "I-T-E" circuit breakers and "C S" switches, sufficiently large to meet all ordinary demands without delay.

THE MIDLAND ELECTRIC COMPANY are introducing a dry battery which they state is about as near perfection as it is possible to attain. They sell for fifty cents per cell, with liberal discounts to the trade.

MR. F. M. LOCKE, Victor, N. Y., is doing a good business in insulators, especially in the triple petticoat patterns in china and glass for all line construction.

THE BERLIN IRON BRIDGE COMPANY guarantee their corrugated iron roof covering not to drip in the coldest weather. Being fireproof as well, it commends itself for use in the construction of machine shops, boiler rooms, lighting plants and other buildings where the fire risk is great.

THE CLIMAX GAS ENGINE COMPANY, 31 Fulton street. Brooklyn, invite inspection of one of their engines exhibited with a volt, ampere and gas meter in full view, showing very plainly the amount of gas consumed and the amount of energy generated.

THE WESTON ELECTRICAL INSTRUMENT COMPANY call attention to a line of cheap but excellent instruments for direct current circuits, well adapted for isolated plants.

THE ELECTRIC APPLIANCE COMPANY give a few good reasons why it pays to purchase "O K" weatherproof wire.

NEW YORK NOTES.

IN THE BIG STORE.—The new inclosed arc light has been put to a most complete practical test in the Siegel-Cooper Building of New York, which is equipped throughout with the "Pioneer" lamp. All visitors to the "Big Store" have commented on the softness, steadiness and noiselessness of this new daylight. The "Pioneer" is manufactured by the Electric Arc Light Company, of 687 and 689 Broadway, New York.

WESTERN NOTES.

THE WALKER COMPANY, Cleveland, report that owing to their large and growing business on the Pacific coast, they have found it necessary to establish a branch factory in San Francisco, at the corner of Fremont and Howard streets.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

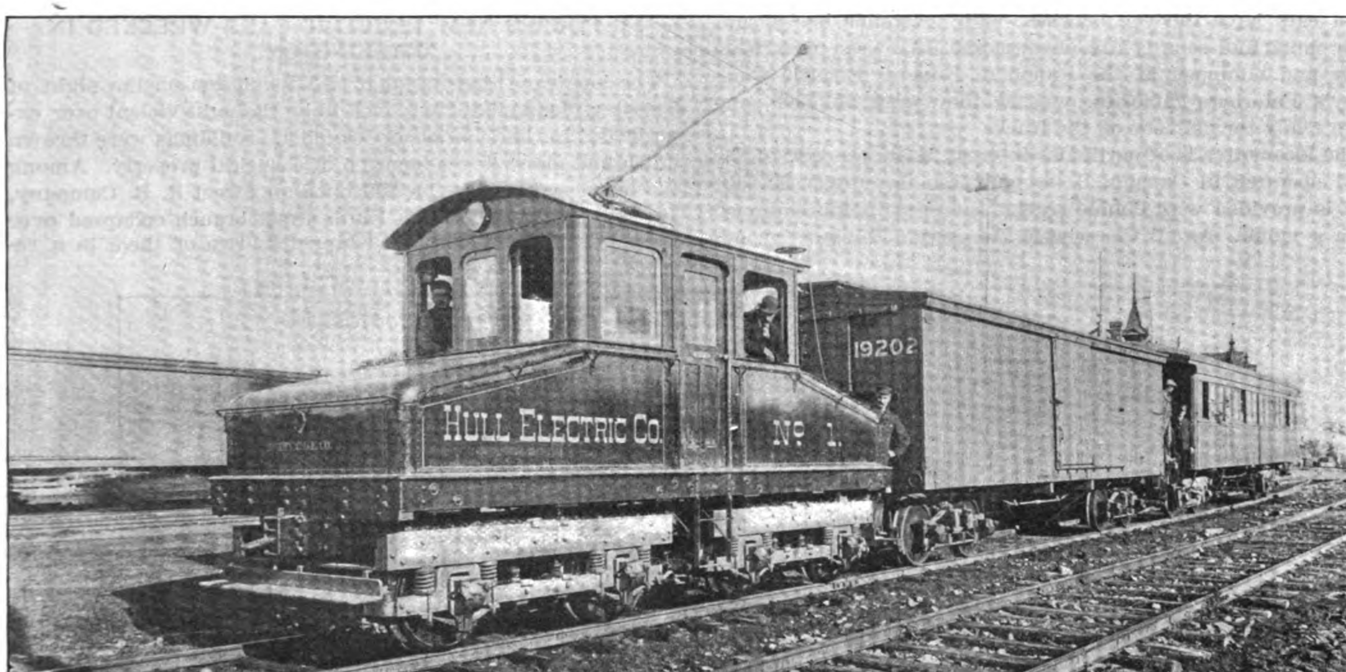
Vol. XXII. OCTOBER 7, 1896. No. 440.

Electric Transportation.

THE AYLMER BRANCH OF THE CANADIAN PACIFIC RAILWAY OPERATED BY ELECTRICITY.

THE latest development in Canadian electric railway work is the equipping of the Aylmer branch of the Canadian Pacific Railway with electric service. This line extends from Hull, a suburb of Ottawa, to Aylmer, where it connects with the Pontiac Pacific Junction Railway, extending 60 or 70 miles up the north side of the Ottawa River. The section from Hull to Aylmer has been leased by the Hull Electric Company for a term of thirty-five years, the understanding being that, besides passenger and mail traffic, they are to handle all through and local freight delivered to them by either the Canadian Pacific Railway or the Pontiac Pacific Junction Railway. As they are the only connecting link with the Pontiac Pacific Junction road, it can readily be understood that the quantity of freight is considerable, amounting usually to fifty or seventy-five cars per day. This freight is mostly handled at night, leaving the road free during the day for passenger traffic.

At the Aylmer end of the line the company owns sixty acres situated on Deschesne Lake, a sheet of water three miles wide by twenty-seven miles long; an ideal spot for sailing and boating, thus forming a strong attraction for the Ottawa citizens. Indeed, the traffic has been far beyond expectations and the train service had to be increased until they are now running thirty-six regular trains each way per day, besides special excursion trains.



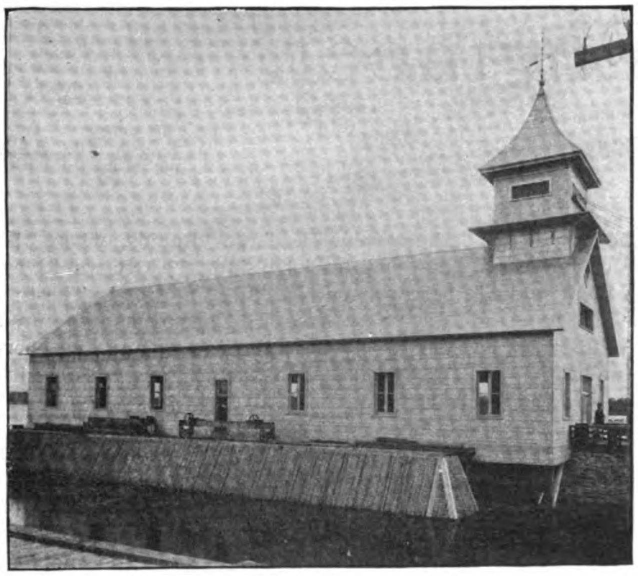
Electric Freight Locomotive Operating on Branch of Canadian Pacific Railway.

The power is obtained from Deschesne Rapids, where the lake of the same name empties itself into the Ottawa River, at a point midway between the termini of the road. The turbine wheels are of the "New American" type, manufactured by William Kennedy & Sons, of Owen Sound, Ont., and operate under a head of 9 feet. Four 60-inch wheels are now installed and space is provided for two more.

The electrical equipment of the power house consists of two M. P. 4-200-425 generators, built by the Canadian General Electric Company. For controlling the output of these machines there is a white marble switchboard, consisting of two generator panels, two feeder panels and a total output panel; all of the General Electric standard type and supplied by the Canadian Company. Besides these, there are three panels containing the "Barbour" water wheel regulator, by which the current output of the generators is automatically kept constant by cutting in or out dead resistance as the load varies on the line. By this means the speed of the machines is kept constant and the variation in voltage is held within a very close limit.

The car sheds and repair shops are also at Deschesne and are fully equipped with all modern appliances for handling and inspecting the rolling stock which at present consists of five closed cars and five open cars, besides a mail, baggage and express car and a locomotive. All the cars are mounted on double trucks, and are each equipped with two G. E. 1,200 motors with K. 21 controllers. They are said to be the finest electric cars in Canada. The closed cars are 42 feet long over all, and finished in mahogany throughout, the outside sheeting being also solid mahogany finish, in the natural wood.

These cars have extra large vestibules at each end, provided with seats for the accommodation of smokers, and divided from the main part of the car by double sliding doors. The



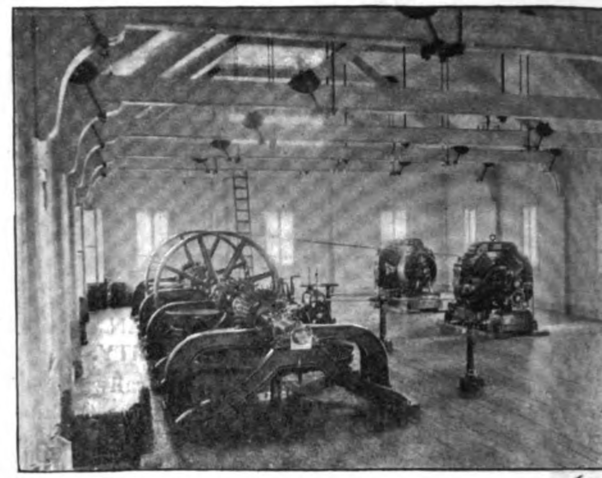
Power House, Hull & Aylmer, Can., Electric Railway.

open cars have thirteen benches, with reversible backs, and their finish and solidity are unsurpassed. All these cars were built and equipped at the Canadian General Electric Company's Peterboro factories, whence they were shipped complete ready for delivery on the track.

The locomotive is of particular interest, being the first of the kind operated in Canada. It weighs something over 20 tons and is provided with double trucks, each axle being equipped with a motor. As all the wheels are driven, full traction advantage is obtained from the total weight and a drawbar pull of 10,000 pounds can therefore be exerted, equivalent to the power of the average 35 or 40-ton steam locomotive. This was also designed and built by the Canadian General Electric Company.

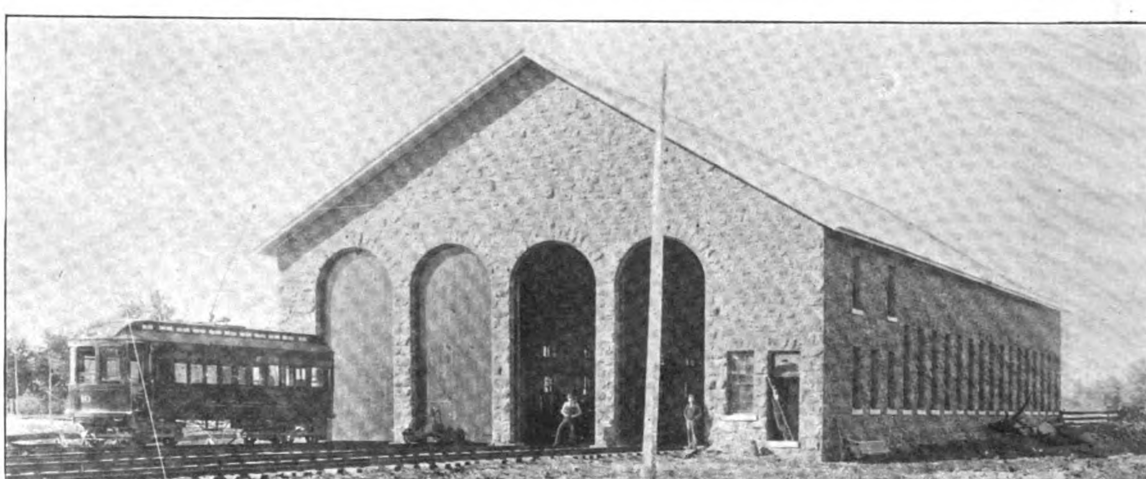
In equipping this road the Hull Electric Company have evidently constantly kept before them the maxim that the best is the cheapest in the end, and will no doubt reap the advantage by long life in their apparatus and small repair bills. The president of the company is Alexander Fraser; vice-president, W. J. Conroy; secretary-treasurer, James Gibson, and managing director, H. B. Spencer.

Besides operating the railway the company have also exclusive privileges for both private and public lighting in the city of Hull and the town of Aylmer, and for the purpose



Interior of Power House.

there is installed at the power house a 150 kilowatt monocyclic generator with a standard switchboard panel and equipment.



Car Barn, Hull & Aylmer, Can., Electric Railway, and Motor Car.

FIFTY-TWO NEW ELECTRIC CARS WRECKED IN WASHINGTON.

The hurricane that swept over Washington on the night of Tuesday, September 29, proved to be the most violent ever experienced in the District of Columbia. Buildings were thrown down and many losses reported of electrical property. Among the heaviest losers is the Metropolitan Street R. R. Company. Its large carhouse for the Ninth street branch collapsed over its handsome new cars, smashing fifty-two of them in a remarkable manner. The structure, which was a brick one, with a steel roof, had its girders so spaced that in falling over the cars, which were stored in four trains, many of them were cut in halves, each girder crossing four tracks. The carhouse is 80 feet wide and nearly 300 feet long and the cars, nearly all of which are hopeless wrecks, present an extremely sad appearance.

SPECIAL TROLLEY CAR ADVERTISING.

The Flint Company lead, as usual, with the novel idea of utilizing the cars of the Union Railroad Company, and have secured that privilege for advertising. Ahead of the monster Labor Day procession was a large trolley car decorated with flags and bunting, and covered with brilliant canvas, an-

nouncing Flint's grand gift sale—$1,100 given away in 10 grand prizes—a coupon with every purchase—easy installments, etc., while inside a large orchestrion discoursed classical and popular music to the multitude. It was conceded by one and all to be the most novel advertising ever seen in the city of Providence.—Providence "Journal."

THE ELECTRIC FOUNTAIN IN WILLOW GROVE PARK, PHILADELPHIA.

BY H. S. K.

THE electric fountain in Willow Grove Park, was designed by Mr. F. W. Darlington, Mechanical and Electric Engineer. The Park is a venture of the Traction Co. in the line of a refined resort and the nature of this venture can be inferred from the fact that Willow Grove has been called Philadelphia's Fairy Land.

The complete success of an electric fountain involves both science and art, and to their combined application is due the rapid developments made within the last few years. The fountain under consideration is an example of the application of the successful principles of the past and the introduction of new features.

One of the fountain's characteristics is its daylight attractiveness. An element of the landscape gardening, it is in beautiful harmony with its environment, and at the same time it has an independent charm of its own. The Fountain, Lake, Observation House, Sloping Banks, and Drive form a pleasing group; yet the Fountain is the striking feature. It stands out in the lake, surrounded by a low wall whose rounded corners are surmounted by diminutive columns. Within and higher is the second basin, whose bulging sides curve into columns that are capped with graceful vases. The pipes, jets and funnels are unobstrusive. There is a completeness about the daylight fountain that little suggests its latent possibilities.

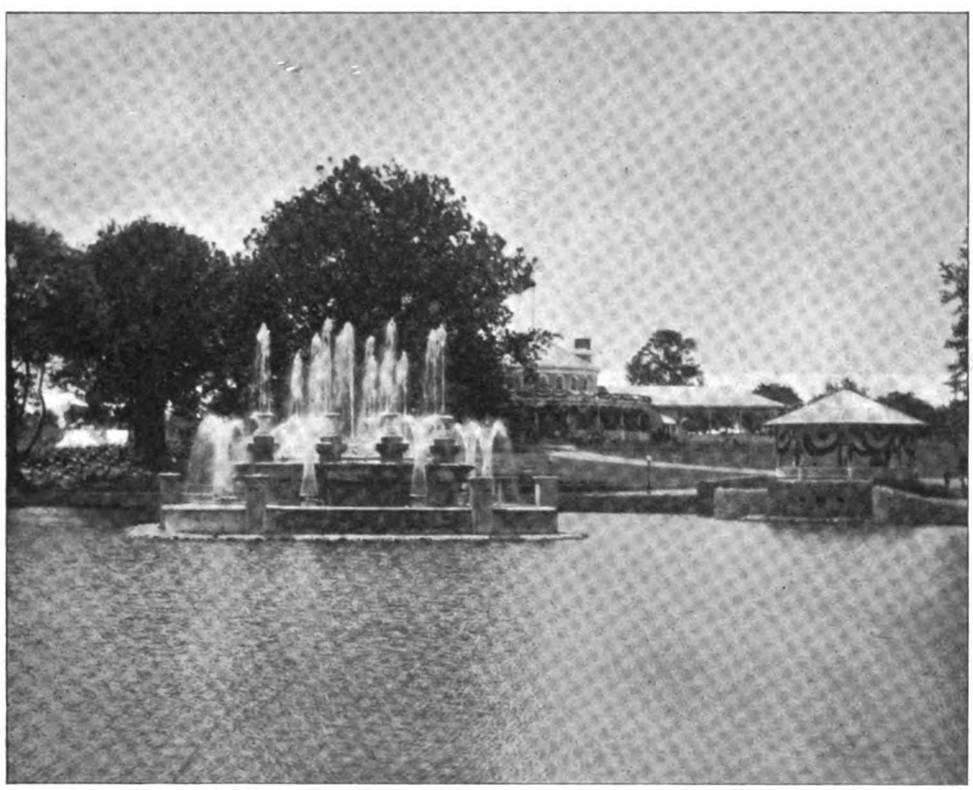
Electrically the fountain is built upon the principle of illuminating the jets in the direction of their length. The illumination is produced by lights concealed within the base. There is in reality a fountain of light as well as a fountain of water. Both light and water travel the same path, hence the illumination. The light passes through glass windows in the roof of the chamber beneath the fountain into sloping funnels whose upper ends clear the surface of the water. These funnels are surrounded with jetted pipes, and within each is a nozzle.

This method of illumination allows a simple solution of the color problem. A rotating color disc is interposed between each lamp and its window. But the illumination need not be limited to ascending water, for the upper cascade may have colored light thrown on it through windows in the sides of the second basin. Moreover the introduction of the fan opens up possibilities of scenic projection. Pictures can be thrown upon this screen from the controlling house on the shore.

In addition to being the source of light electricity is also the source of power.

The electric equipment consists of lamps, motors, and controlling devices. There are fifteen arc-lamps of the Rushmore Dynamo Works make. They are focusing and reflecting and of 8,000 candle power. There are two G. E. 2,000 motors operated by series multiple controllers. The motors drive the pump and get their power from the Traction Company's line. The lamp circuits are controlled from a marble switchboard.

The pump is of the Gould make and has a normal capacity of 1,000 gallons a minute, with sufficient margin to give 1,200 to 1,500 gallons at a pressure of 100 lbs., when necessary. It gives an average height of 100 feet to the streams, but can project the solid central jet to 150 feet. The pump is under complete control, which adds to the flexibility of the fountain.



ELECTRIC FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.

A tunnel connects the chamber beneath the fountain with the basement of the controlling house under the pavillion on shore, where the motors and pumps are located. The water is pumped over and over again, for the supply is taken from the lake. The pump is controlled from the alcove, and from here the action of the fountain can be observed. In the alcove are also the main valves, the lighting switchboard, the twenty-four levers of fourteen positions each for controlling the water jets. The entire system is simple and flexible and, with so many variables, streams, sprays, lights, colors, and pressure it is not surprising that the number of effects that can be produced is legion.

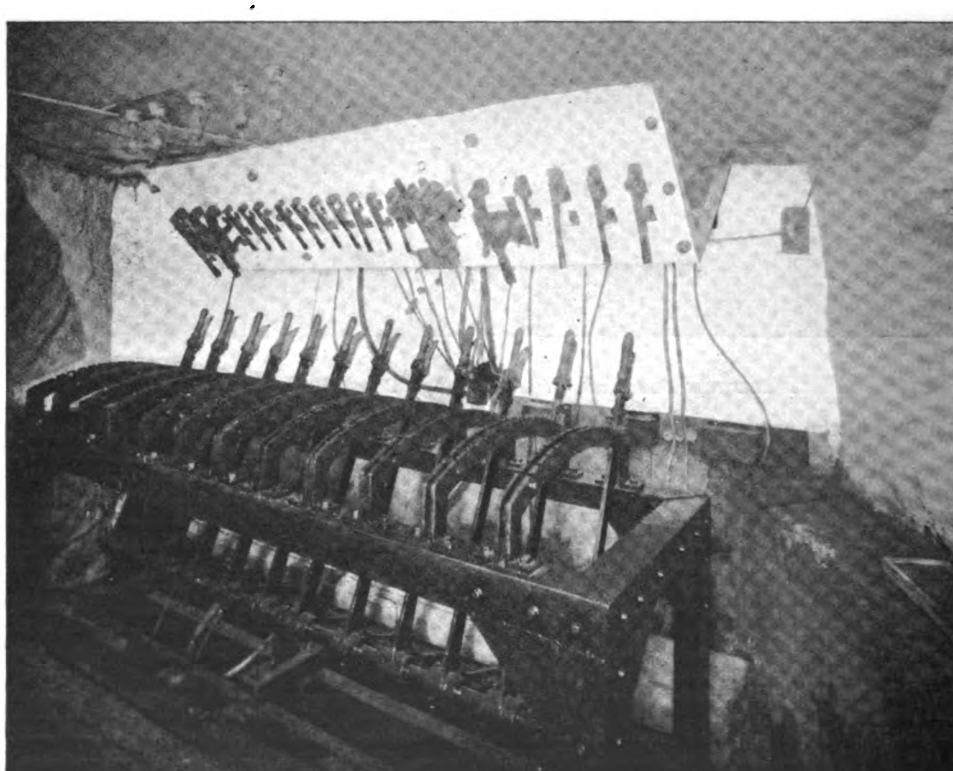
The fountain itself is simple in design, consisting essentially of a foundation and two basins. The foundation lies entirely below the surface of the lake and contains the chamber in which the lamps, the reflectors, and color devices are located. It is built of cut stone and is 44 feet square. The superstructure which it supports is built of iron, stone and brick and is octagonal in shape. The lower basin rises three feet above the lake and measures 24 feet across; it supports eight columns and contains eight light funnels. A big ring pipe encircles the entire circumference, eight smaller ring pipes surrounding the light funnels, and eight one-inch nozzles. The columns are appropriately decorated. The second basin rises

5 feet above the first and is ornamented with vases. It contains large and small ring pipes, light funnels, and, in addition, two big arched pipes.

ELECTRIC FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.

to give massive spray effect. The nozzles of the little ring pipes are arranged for the wheat sheaf effect; and the one-inch internal nozzles are designed for columns. Both large

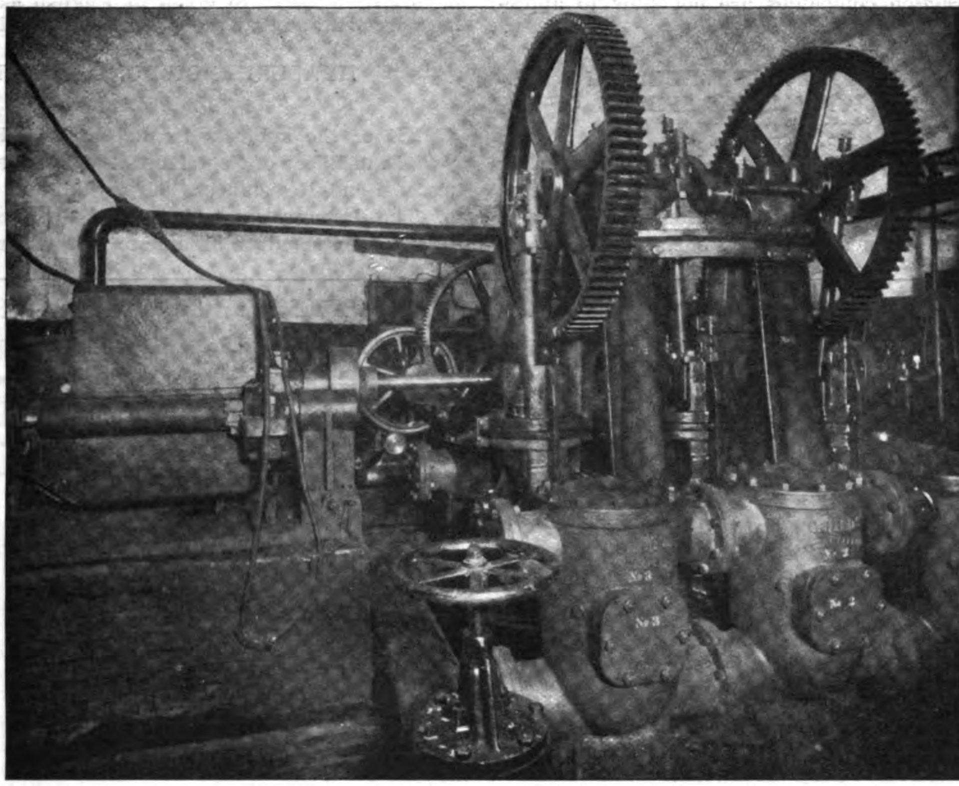
ELECTRIC FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.



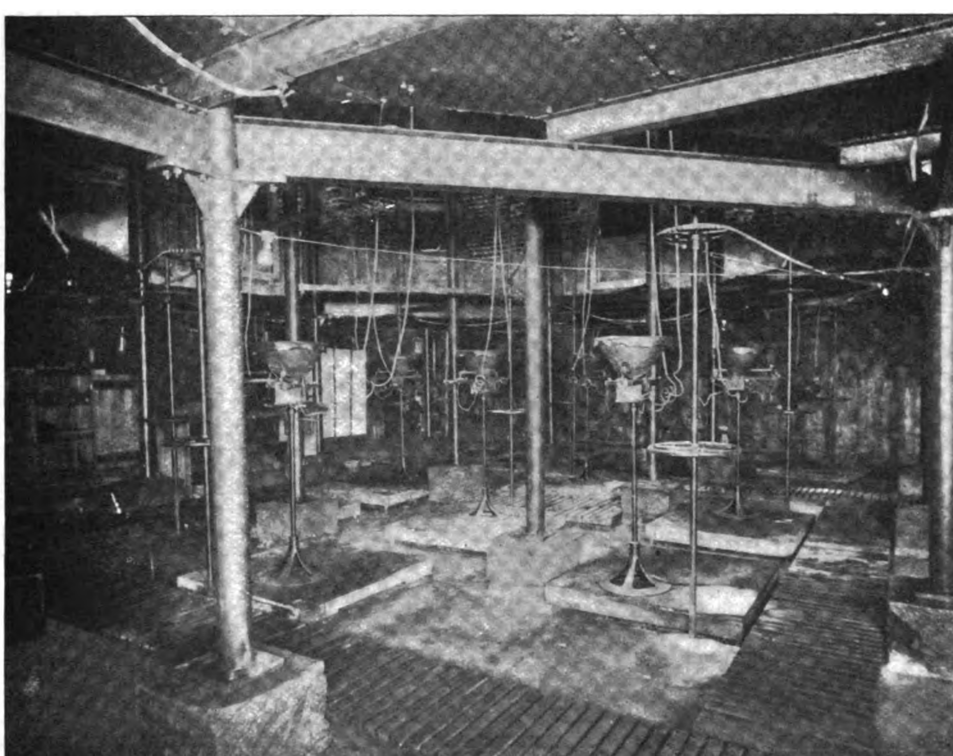
CONTROLLING APPARATUS FOR ELECTRIC FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.

Since the artistic success of the flowing fountain depends primarily on the design of the nozzles, they have received special attention. The ring pipe in the lower basin is jetted and small ring pipes in the second basin are intended for spray effect and the design can be changed from time to time, thereby increasing the possibilities of the fountain. Six of

the big nozzles throw an inch and a quarter stream, and the middle one an inch and a half. The two arched pipes are jetted in such a manner that the entire screen can be illumi- red, and are operated from a rack. The rack is so constructed that the discs can be operated singly or in groups; consequently a multitude of combinations can be produced.



ELECTRIC PUMPS DRIVEN BY RAILWAY MOTORS, OPERATING ELECTRIC FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.



PROJECTING APPARATUS IN CHAMBER UNDER FOUNTAIN, WILLOW GROVE PARK, PHILADELPHIA.

nated. Simplicity is also a characteristic of the color mechanism. The fifteen color discs are supported on vertical shafts, contain five colors, white, orange, purple, green and

The accompanying illustrations show the interior of the chamber below the fountain, the electric pumps and some of the innumerable phases of action into which the fountain can

be thrown. Of course the color effects must be left to the imagination.

This is Mr. Darlington's second fountain, as he also designed the one in Schenley Park, Pittsburg. Its success demonstrated possibilities that traction companies are not slow to appreciate.

CHART SHOWING REVOLUTION OF WHEELS AND DISTANCE TRAVELLED AT VARIOUS SPEEDS OF STREET CARS.

EVERY street railway superintendent and engineer, whether electrical or mechanical, is constantly called on to solve questions involving the number of revolutions of wheels of different diameters, distance travelled, etc., of street cars.

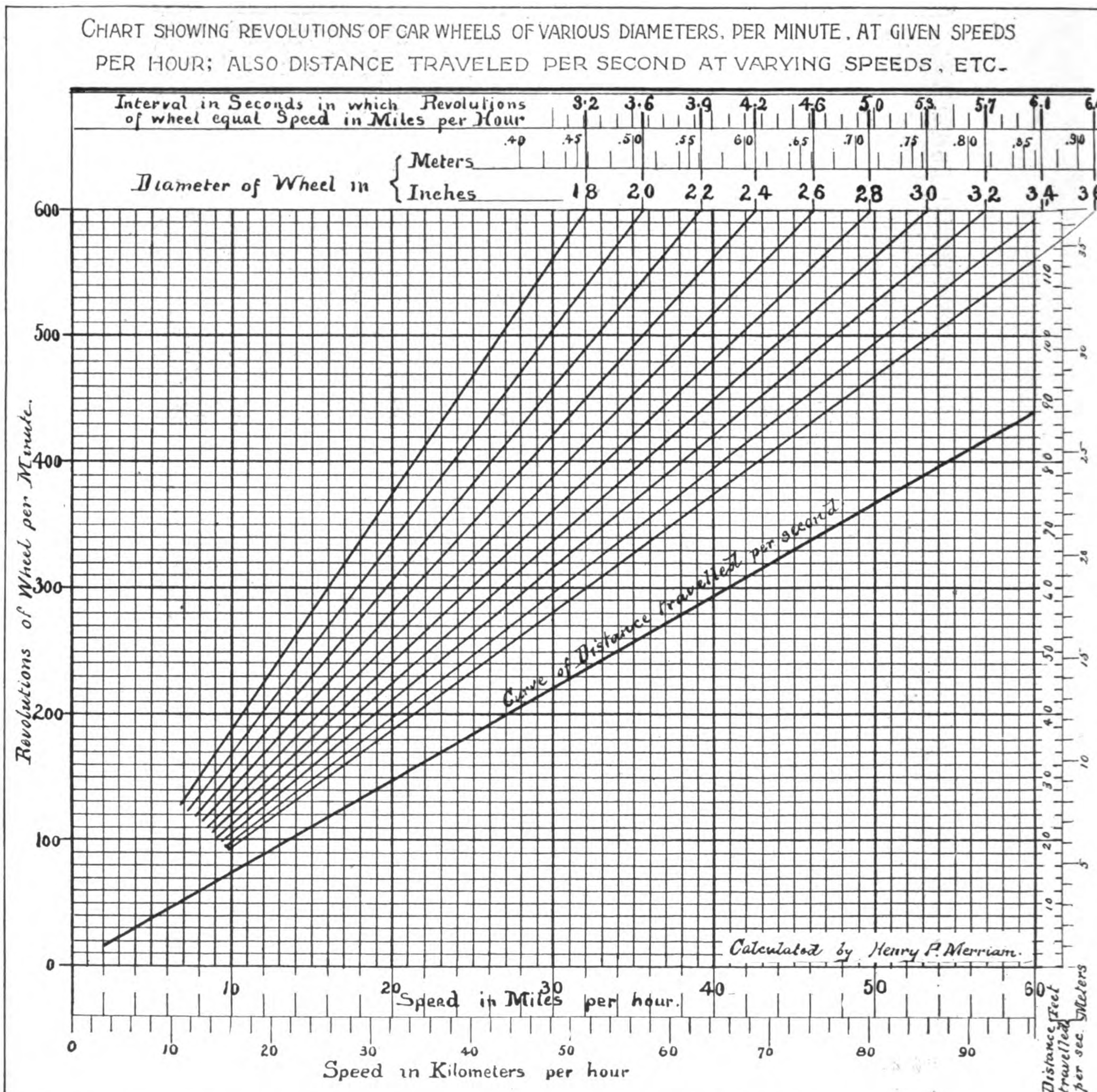


CHART SHOWING REVOLUTIONS OF CAR WHEELS OF VARIOUS DIAMETERS, PER MINUTE, AT GIVEN SPEEDS PER HOUR, ETC.

These points are of particular moment in considering the question of effective braking. Hence it is with special appropriateness that the Standard Air Brake Company, of New York, have included a chart giving this information in a neat folder to be distributed at the St. Louis convention this month.

This chart shows at a glance the number of revolutions of car wheels of different diameters, per minute, at given speeds per hour; the distance travelled per second at various speeds; the interval in seconds in which revolutions of wheel equal speed in miles per hour, etc. All linear distances and diameters of wheels are given in English as well as in metric measurement, so that the chart is applicable the world over.

MEASURING OF BOND RESISTANCES.

BY J. C. HENRY.

ONE of the subjects treated by The Electrical Engineer Data Sheet of September 2 (508, Sheet 3) is the Measuring of Bond Resistances. Three different ways are referred to. The first appears to be passed upon as generally impracticable; the second we assume to be the same as that described in The Electrical Engineer of July 1, as the writer's invention; the third seems to be theoretically the same as the second. Calling my instrument a differential ammeter, and the other a millivoltmeter, "having the zero in the middle of the scale," makes no difference in the scheme or in the results. The fact is, they are both differential galvanometers. They are both used to show at a glance what is going on in two separate cir-

cuits, and they are both used to compare the resistance of one section of track with another. Plan No. 3, however, has the advantage that the tests may be carried on by one person measuring but one joint at a time.

Our practice has required one man and two boys who take in four or more track points at a time. When trouble is noticed on either circuits we close in and make precisely the same connections as shown in plan 3. These methods originated with me. They are protected by Claims 1 and 2, Patent 540,054, of May 28, 1895.

That my statement and the invention may be better understood, permit me to trace out the evolution of the latter. The greatest inventions are those so simple that it is difficult for an outsider to see any invention in them. Although as in this case they are usually evolved in a very clumsy manner. In 1892 I applied for a patent, now No. 508,615, of November 14, 1893, on a distribution system where the track rails are reinforced by an insulated conductor connected to them at intervals, the object of this plan being to provide a shunt around rail bonds which might become injured and to offer an insulated path for that portion of the circuit which was inclined to leave the rails owing to poor bonds and thus prevent the injury to underground pipes, disturbing telephone circuits, etc. The general plan was to carry this supplementary wire on the span wire poles. While this plan was under consideration it occurred to me that by placing an ammeter in the supplementary conductor we could form some idea of what the current was on the track, and consequently determine the condition of the bonds. This looked like a very desirable scheme, but we were dealing with a varying current which caused a fluctuating resistance in the track joints, and we had nothing standard to compare with. Then it occurred to us to measure the current in two adjacent sections simultaneously. Assuming the chances of their both being defective to the same degree was very slim. Our arrangement at this time consisted of spring switches on the poles and a pair of portable ammeters to be inserted and read simultaneously.

The next step was to bring the two meters together by portable conductors. At this stage of the invention we learned we were not smart enough to catch the reading on both instruments when their needles were fluctuating. There being no such instrument on the market, we were compelled to experiment with and design one suitable, having but one needle controlled by two circuits. Now having the portable conductor and a single instrument we were enabled to dispense with the overhead shunt conductors, and thus put the method within reach of all roads.

Such is our "Resistance Detector" in its present shape, and now that I have exposed to the novice how inventions are made, I might save them lots of trouble by advising not to attempt to make them. It is so much easier to use the other fellow's, if it happens to be worth struggling for, owing to the loose patent laws and nefarious court decisions. He cannot stop you without spending a fortune and years of time. Then after the subject has been thoroughly ventilated, you may safely depend upon some one telling you how to do it in another way.

A NEW DAY SUMMER RESORT.

ONE more summer resort is about to be added to the large number already in the vicinity of Greater New York which have been made accessible by the adoption of the trolley system. Midland Beach is the name given to a portion of the southeast shore of Staten Island which is undergoing extensive alterations and improvements at the hands of the Staten Island Midland Railway Company, who are also extending their system to various towns throughout the interior of the island.

EDUCATIONAL.

UNIVERSITY OF WISCONSIN.

The catalogue of this Univerisity recently received mentions as special lecturers: W. E. Baker, of the Metropolitan Road, Chicago, on "Electric Equipment of Elevated Railroads;" John Lundie and L. L. Summers on "Motorcycle Tests;" R. H. Pierce, Chicago, on "Electric Storage Batteries from an Engineering Point of View." D. C. Jackson remains professor of electrical engineering, and B. F. Snow, professor of physics.

MR. C. E. MAGNUSSON, in the engineering department at the University of Minnesota, has won the $30 prize and gold medal offered by the Gillette-Herzog Company for original theses. His subject was "Specifications for an Electric Light Plant." There are three such prizes given annually on the award of a committee of engineers.

ELECTRIC LIGHTING.

THE DESIGN OF LARGE ARC DYNAMOS.

BY GEO. ALBERS.

WHATEVER the arc lighting station of the near future may be, it will not consist of a large number of small series dynamos, separately belted to a countershaft, nor will it consist of large constant potential, continuous current machines; nor will alternate current lamps probably be allowed. Designers have given much thought and experiment to the solution of the problem along these lines, but arc lighting has grown beyond their compass.

Recently inventors have sought to run a number of series circuits from the same dynamo, in parallel, or from independent windings overlapping on the same armature core. The first of these is the extreme of consolidation, opposed to the extreme of subdivision, which is the present method of running each circuit from its own little independent dynamo. The second is the first step toward subdivision, for now each series circuit has its own armature winding. The second step also has lately been proposed.[1] It is to divide the armature into segments and place the winding for each circuit on its own separate segment. This gives us much better latitude in the choice of regulators than does the multiple-series arrangement. Is it not possible that there is a practical limit, which just includes all the advantages of extreme subdivision, and at the same time gives us, from a single shaft and commutator, the high economy and small floor space of consolidation? It would seem that there is, and that the machine representing this limit must be an aggregation of units, each of which will have its own magnetic circuit, armature and field coils and regulator, but possesses its moving part in common with the whole station.

There is also a practical limit to the first extreme. For we cannot subdivide a continuous current and regulate it so that each parallel branch will be a good arc circuit, and we do not wish to send an alternating current to our lamps. So, if we are to have one large multiple series dynamo, we will be obliged to have separate commutator for each circuit, and to place our regulator either between the armature coils and the commutator, or at the commutator (as in the case of shifting the brushes). This prescribes that our dynamo shall be a multiphase alternator with the commutators for each circuit run in synchronism with it. They may be run by synchronous motors or by gearing them to the armature shaft, as Prof. Thomson proposes.

If an armature is to hold very many independent circuits, it must be so large that the dynamo will be multipolar. This usually involves for each commutator, several pairs of brushes connected in parallel, or elaborate cross-connections in circuits of high potential, or running the commutators at a higher (synchronous) speed than the main shaft. In the third case each commutator must have as many collector rings as segments, and, to avoid the large number of collector rings on the main shaft, the naturally bulky armature should be stationary. Designers of arc machines seem to have overlooked the fact that because the armature is stationary it does not follow that the field magnet shall rotate.

About a year ago, in a paper read before a local society,[2] the writer proposed two types of machine growing out of the above reasoning. This paper was almost immediately followed by the issue of Patent No. 548,406, showing that Prof. Elihu Thomson had previously applied the same ideas, including even the details of regulation. Yet, in one of these two types, the manner of applying them differs so greatly from anything that has yet been published, that it is described here as an example of the above mentioned, extreme practical limit of subdivision of units for a large station. In the original paper it was proposed to install a commutator for each circuit; the several commutators to be mounted on the shaft of a synchronous motor; but the complex commutator here described seems to be a more logical accompaniment to this design.

Figs. 1 and 2 show an electric light station, in which, for the purposes of this article, we will speak of the individual stators, 1, 2, 3, 4, 5, 6 and 7, as separate dynamos. Thus 1 is an incandescent "dynamo" and the other six are arc "dynamos." The paths of the magnetic circuits are readily seen in Fig. 2. From the left half of Fig. 1 one limb of each field magnet with its accompanying pole piece has been removed, so as to show the rotating part. The various parts are: A, A, etc., field magnets; P, P, etc., pole pieces; C, C, etc., rotating

[1] By Elihu Thomson, in Pat. No. 548,406, Oct. 22, 1895.

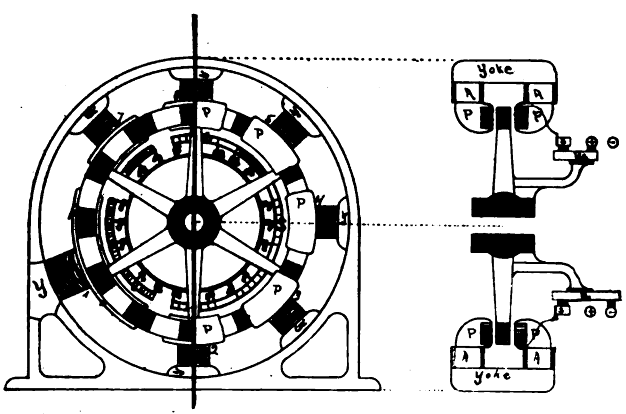
[2] The Electrical Seminary of Kansas University.

keepers; the armature coils, or, more properly, the induced coils, not shown, are laid directly upon the laminated pole pieces, or in radial grooves in their laminations; S, S, etc., commutator segments; B, B, etc., rotating brushes; + and —, collectors or terminals.

In the operation of the machine, the passage of a keeper is accompanied by a wave of electromotive force in the several coils in succession; we may speak of the crest of the wave as positive and the hollow as negative. The moving brushes make contact with the stationary commutator at points corresponding to the crest and hollow of each wave, and also make contact with the stationary collectors. Each brush is electrically independent of every other, and serves merely as a connecting link between the commutator and a positive or a negative collector, during the short time that it occupies in passing any given dynamo. In this manner it makes the round of the station. To connect with the two collectors of each machine there are arranged alternately "long brushes," B_1, Fig. 2, and "short brushes," B_2. They are alike in the parts that make contact, but differ in the length of the piece that joins the part bearing on the commutator to the part bearing on the collector, so that every alternate brush shall slide on the collectors located furthest from the commutator, while those between shall slide on the nearer ones.

The collectors differ from the familiar collector rings only in that they are not complete rings, but are divided into arcs of the circle of revolution which the brushes make. Their angular length is equal to that of the pole pieces of the several dynamos to which they belong. Thus, each dynamo has its own pair of collectors which form its positive and negative terminals, each of which is at all times in contact with at least one brush.

The number of keepers is 50 per cent. greater tnan the number of dynamos, or, more correctly, than the number of angular units into which the station is divided. (In the figure the incandescent machine occupies two angular units.) This keeps the magnetic circuit complete at all times, but, in order that its reluctance shall be constant, the pole pieces should be cut away slightly, near their edges. For, when one keeper is just leaving the space between a pair of poles, and another is just entering it, the magnetic circuit is completed through two keepers, and, therefore, the air gap should be a little greater near the ends of the space than in the center.



Figs. 1 and 2.—Albers Composite Inductor Dynamo.

Though the arrangement provides for laminated pole pieces, it should not be inferred that a large amount of iron is subjected to hysteresis loss; for the total depth of laminated iron, including that in the two pole pieces and the keeper, should be less than the diameter of the armature of an old style arc dynamo. Moreover, the direction of magnetization in the keepers need not ever be reversed; for it is convenient to have all the north poles at the front of the "complex station" and all the south poles at the rear, or vice versa.

In the armature of any continuous current dynamo, the current divides in passing from brush to brush, and goes through the two halves of the armature in parallel; in this dynamo these halves are stationary and independent, being fastened on the two opposite polar faces. They may, therefore, be used to supply different arc circuits. In this case, however, our composite electric light plant must have two commutators instead of one, as described above. This is a step away from extreme subdivision but, in practice, it is a good step to take.

Such a station will have a very large output in proportion to its size. Suppose, for example, we wish to supply current for 1,600 lights. If installed according to the so-called modern method, with sixteen 100-light dynamos belted to a countershaft, compactly arranged by belting in tandem in pairs, and allowing just space enough to get around each one, the floor space required for the dynamo room would be not less than 35 by 50 feet, and in practice would usually be very much more. On the other hand, if such a composite station as is here described were used, assuming the polar breadth of each dynamo to be two feet, and the space between poles of neighboring dynamos to be one foot, and that eight 2-circuit machines be employed, the diameter of the rotating part would be eight feet, and the whole generating plant would be encompassed within a circle, in a vertical plane, about twelve feet in diameter. Moreover, each additional 200-light unit would increase the radius of the plant but six inches.

We have yet to speak of regulation. The stationary armature enables us to use several methods not otherwise possible. In the composite station we are able to use any means of regulation practicable on any arc machine. One apparent and partial exception to this rule is the case of shifting the brushes. If that part of the commutator which belongs to any given dynamo has a clear space on each side of it, as shown on the left half of Fig. 1, so that it may be rotated through a short arc about the common center without striking the parts that belong to its next neighbors, on either side, then we may regulate by shifting the commutator, which is obviously the same thing, so far as regulation is concerned. If, on the other hand, we find that these blank spaces cause serious "jumping" on the part of the brushes, so that we are obliged to fill each one with a broad dead segment, as shown in Fig. 1 on the right, which will probably be the case, we will be deprived of this method of regulation.

There is, however, still another way of accomplishing the electrical equivalent of shifting the brushes; it is to insert choke coils with movable cores into the circuit on its way from the induced (armature) coils to the commutator segments—retarding the waves of current by the coils answering the same purpose as shifting the brushes forward. Where there are but few segments, this method of regulation is very convenient. With most styles of winding, only half as many choke coils as segments will be required.

Imagine a row of from three to six choke coils, according to the number of segments, with movable, pointed, laminated iron cores fastened to a common bar at their large ends. The arrangement of cores will resemble a rake; now suppose that the rake is pivoted at a point in its handle, so that it is free to swing, like a pendulum, in the direction that the teeth point. As the current in the coils increases, the cores will be drawn further in, thus increasing the choke effect. By properly choosing the shape and weight of our cores, this regulator will keep the current constant within ordinary working limits.

We might replace the choke coils by constant current transformers, or we may regulate by automatically cutting in or out induced coils, and even reduce armature resistance on light loads by throwing the two opposite sides of the dynamo in parallel through one commutator.

Indeed, the flexibility of this system exceeds in some respects that of the old way of energizing each circuit by its own separately belted dynamo. With but one common moving part we retain the ability to run continuous and alternating current dynamos of as many types as we desire, including constant current and constant potential, with open coils on some and closed coils on others, with different numbers of commutator bars, and any variety of regulators.

A departure from this extreme must sacrifice something of flexibility, yet, as a rule, this is not objectionable in practice. A step toward the conventional form but retaining the composite idea, might in brief be as follows: Let the magnetic circuits and general form of the machine be the same as in the diagrams, and let all dynamos be arc machines and exactly alike. Let the rotating part carry the armature coils in one continuously overlapping winding around the whole circle. This winding need not necessarily be "open coil," nor is iron really necessary in the magnetic part of the armature. Give each dynamo (stator) its own pair of stationary brushes. If two circuits, one from each side of the armature laminations (if there are any), are to be taken at each dynamo, then the station will have two rotating commutators, exactly analogous to the two stationary ones mentioned in the description of the extreme type.

If it is true, as assumed at the outset, that the arc lamp of the future will be actuated by a continuous current, then we may say, with a good degree of confidence, that hereafter designers of very large arc dynamos should confine their efforts to the fertile field within the two rather near extremes, of which one is represented by the multiphase alternator with a separate commutator in each circuit, and the other by an aggregation of nearly independent units as in the inductor above described.

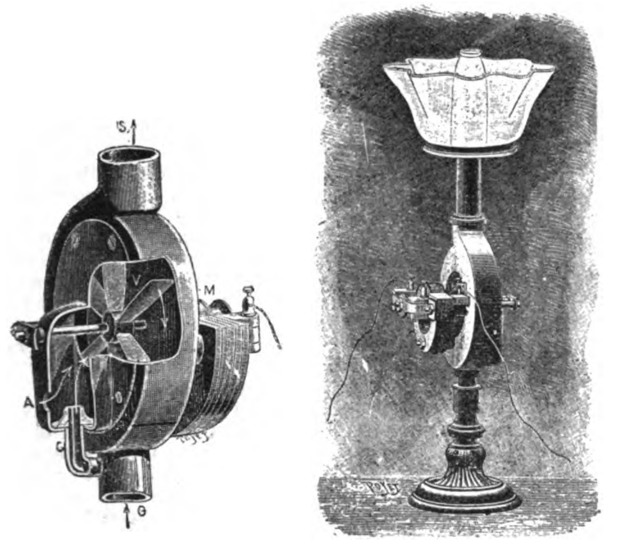
NEW LONDON, CONN.—The New London Street Railway Company proposes to introduce electric power into the city, supplying from its circuits.

THE DENAYROUSE GAS BURNER.

AMONG the latest aspirants to lighting honors and an alleged rival to the incandescent lamp is the Denayrouse burner, which may be described as a sort of combination of the Welsbach and the old "moderator" oil lamp. In the Denayrouse burner, to which we have already called attention, the object aimed at is to establish a thorough mixture of the air and gas before it reaches the point of ignition so that it may develop its highest heating capacity.

The engraving, Fig. 1, taken from "L'Illustration," shows the Denayrouse mechanism in detail, and Fig. 2 shows the lamp complete.

The apparatus consists essentially of a bronze or brass box



FIGS. 1 AND 2.—THE DENAYROUSE INCANDESCENT GAS BURNER.

in which revolves a fan V, keyed upon an axle that passes through the box. The axle is revolved by means of a small electric motor mounted upon one side of the box. Upon the axle is arranged a speed regulator. The air enters at the bottom of the box at G, and the gas at the center at A. The exit of the mixture takes place through a chimney, S, arranged at the top and to which is fixed a luminous mantle. The apparatus operates as follows: The motor revolves the fan at about 1,200 revolutions a minute. There is thus formed a strong draught of air, which mixes with the gas that enters at the side. The ignition occurs at the upper aperture of the chimney.

It is claimed that the Denayrouse burner consumes 4.4 volumes of air to one of gas, the theoretical perfect combining ratio being 5.5. A writer in "L'Illustration" by an elaborate calculation shows that for the same money, the Welsbach gives four times, and the Denayrouse nine times as much illumination as the butterfly burner.

WILMINGTON, DEL., CENTRAL STATION.

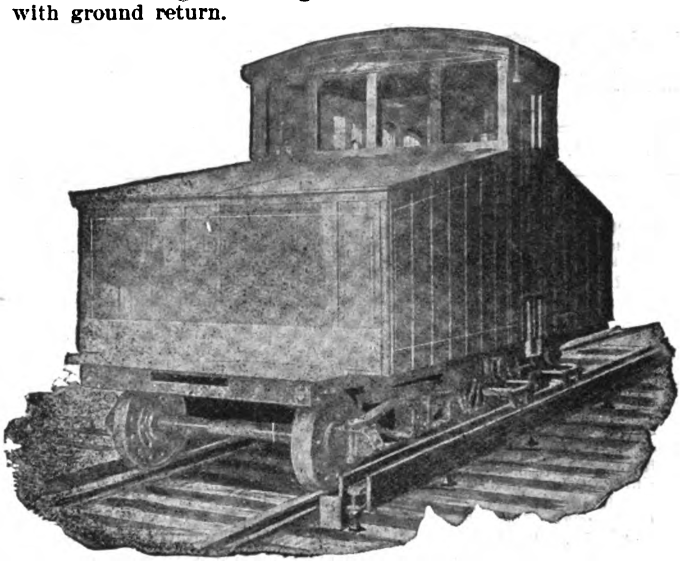
The Wilmington, Del., City Electric Company are reconstructing their old central station, and adding a small annex for storerooms and offices, next to the engine room. The work is being done under the supervision of Mr. C. R. Van Trump, the manager and electrical engineer. The steel work has been supplied by the Edge Moor Bridge Works, of Wilmington. The engine room is one story, 42 feet by 128, with a gallery at the end, which will be the superintendent's office, with the switchboard immediately in front. This board is of marble, and of non-combustible material throughout. The boiler house adjoining is also to be of steel construction with brick partitions built between, carrying the roof. There is a steel wire tower in front which carries the lines directly to the poles from the sides. The new building will not be elaborate in any way, but solid and substantial. No new apparatus will be installed.

CLARKSVILLE, TENN.—The Clarksville Electric Light Company have made an assignment; liabilities $50,000, assets $8,000. H. C. Stacker, secretary, is made assignee and is directed to wind up the company's affairs within ninety days by private or public sale.

NEWS AND NOTES.

STORAGE BATTERY LOCOMOTIVE ON THE N. Y. ELEVATED RAILROAD.

AFTER a long period of quiescence the N. Y. Elevated Railway management have again taken up the consideration of equipping their roads with electric power, and only recently the president of the road made a tour of inspection among the principal railway apparatus shops of the country, to gain further information on the subject. The experiment to be immediately undertaken is in many respects a novel one, involving an electric locomotive carrying a storage battery. The first experiments beginning this week will be carried out on the Thirty-fourth street branch of the Third avenue line, running from Third avenue to the East River, a distance of about a quarter of a mile. The track construction is similar to that employed on the Lake Street elevated road in Chicago, a third conducting rail being laid outside the two main rails with ground return.



THE STORAGE BATTERY LOCOMOTIVE ON THE NEW YORK ELEVATED RAILROAD.

The locomotive, which is illustrated in the accompanying engraving, is mounted on the standard elevated railway trucks, measuring 22 feet 9 inches over all outside the drawbars, with 38-inch drivers. It is equipped with two 125 h. p. motors. each of the General Electric 2,000 type, similar to those employed on the Nantasket Beach Railway. The storage batteries are situated in the two wings on either side of the cab in the center. They consist of 256 cells, placed all in series, and weighing 80 pounds each, thus making the total equipment weigh 10 tons. Each of the cells contains seven plates, three being positives of the Planté type, and four Chloride negatives.

During operation the cells are constantly in parallel with the line, whether the train be in motion or not. Current is supplied to the line at 500 volts, the power being supplied from the factory of the New York Electric Equipment Company, which is within a few hundred feet of the line of the road.

LEGAL NOTES.

A TELEPHONE DECISION ADVERSE TO DRAWBAUGH.

The Court of Appeals of the District of Columbia on Sept. 29 rendered a decision in the case of Daniel Drawbaugh, who was refused patents for certain alleged new improvements in telephone transmitters.

The decision was written by Chief Justice Alvey, and affirms the decree of the Commissioner of Patents. The case was divided into two parts and argued before the court last November. The decision was withheld because of the application of Mr. Drawbaugh to Congress for relief. This application was withdrawn by Mr. Drawbaugh, whose petitions for patents were filed in 1883 and 1884.

The Court of Appeals held that Mr. Drawbaugh never was the inventor of the transmitter.

THE

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CONTENTS.

PRESENT STATUS OF ELECTRIC POWER TRANSMISSION.

ALTHOUGH somewhat slower to obtain that lasting hold on the engineer as well as the public that the electric light obtained almost instantly after its launching into commercial practice, the transmission and distribution of power by electricity has nevertheless established itself with equal firmness. Indeed, it may now boast of having even more zealous adherents. The statistics of transmission and distribution plants, both local and long distance, of the entire world, if they could be got together, would make a formidable demonstration of work accomplished in a comparatively short time. It is just this latter factor, the shortness of time in which the work has been done, that has prevented that crystallization which is the result of slow evolution in most of the other branches of engineering, and hence it was eminently fitting that Dr. Louis Duncan should select as the theme for his second inaugural address as president of the American Institute of Electrical Engineers, the present status of electric power transmission and distribution. As a brief review of a wide field of work, Dr. Duncan's address is an excellent condensation of current practice with comments that will not fail to impress themselves on all interested in the handling of the electric current, whether as engineers or as commercial exploiters.

Taking up the subject from the latter standpoint, more particularly, the fluctuating load on practically all central stations has deservedly received particular attention by Dr. Duncan, and if we read him aright he sees in the storage battery the means for avoiding many of the losses which the general conditions of current distribution have heretofore involved. This is the inevitable conclusion derived from the experience of extended work abroad, which we are glad to note is slowly but surely being taken advantage of in America. A few of our lighting stations have made a good start in this direction, but the small ratio of the continuous current to the alternating current stations in the United States, would indicate that the largest field for this auxiliary lies in the direction of electric railway work. The relative advantages of the location of storage batteries within the station as compared with their placing at centers of distribution is another point touched upon. There can be little doubt that so far as economy of copper is concerned the latter plan is to be preferred, but this would militate to some degree against the strong argument which Dr. Duncan makes for concentration of apparatus in single stations, as compared with the present practice of locating a number of stations at the centers of distribution, as now practiced in low tension distribution systems in our large cities. While theory may bear out the argument for concentration, actual practice does not always; in fact, rarely, confirms it, so far as low tension work up to 220 volts is concerned. Take the case of the great Duane Street station of the New York Edison Company. This station is located within little more than half a mile either way of the water front, and yet careful calculations showed that the economies of operating the engines condensing and the saving in haulage of coal and ashes were not sufficient to overbalance the interest on the investment required by the additional amount of copper which would have been necessary owing to the displacement of the station from the center of distribution. It is conditions like these that frequently compel the adoption of methods apparently at variance with good practice.

The views which Dr. Duncan holds on electric railway work are of particular interest at the present moment when roads are branching out into territories and covering distances scarcely contemplated five years ago. Fifteen mile railway circuits are not at all uncommon, while twenty and thirty mile lines are being operated at the present time. If the operating voltage at the motor is to be maintained at approximately 500 volts, and this will in all probability remain a fixture, something must eventually be done to increase the voltage at the station for the long feeders, if excessive investment in copper is to be avoided. The booster and rotary current transformer have made but very little progress, while the storage battery as a remedy has, to our knowledge, been applied in but one or two instances of this kind, albeit with marked success. It may be looking far into the future, but the alternating system applied to street car service would remove many of the troubles now to be contended with in the drop of line potential on long feeders. That railway companies will have to consider this problem more seriously at no very distant date is apparent, and Dr. Duncan's conclusions on the subject will no doubt have their proper influence on the selection of the methods to be employed.

As regards methods of long distance distribution, if the results of actual practice constitute a valid criterion in this

case, it would seem that the three-phase system is decidedly in the ascendancy. The arguments adduced in its favor have thus far given it precedence, but without desiring in any way to detract from its merits one cannot help feeling that the system is still in a certain sense on trial. Perhaps as good a trial as it will ever have is now rapidly approaching consummation in the Niagara-Buffalo transmission of a preliminary 5,000 h. p.. What is the limit of potential is a question which Dr. Duncan's statistical table brings out in strong relief. The alternate current advocates will certainly extract comfort and encouragement to further efforts in contemplating the success of a 15,000-volt continuous current transmission, but Dr. Duncan has placed the present practical limit at about 20,000 volts, with everything beyond that as experimental. In most discussions of this branch of the subject it appears that one factor is not given the consideration which it deserves, and that is the climatic influence on the insulating properties of the line. Insulators have been and can be produced which will stand 100,000 volts on test under the dry laboratory roof, but when mounted on a pole, other conditions are to be reckoned with. We take it that much of the success of some of the long distance transmission plants in the West is to be credited as much to the dryness of the climate, as to the insulators. It is for this reason that we shall watch with peculiar interest the Niagara-Buffalo transmission, where the conditions are such as the most ardent antagonist of electric transmission could wish for.

There are many points in Dr. Duncan's address worthy of comment, but we must content ourselves with a closing reference to his statement that alternating current lamps are not increasing in number. We do not know on what information this statement is based, but would like to know whether it can be confirmed, if it is so. Far from its remaining stationary, we believe that the alternating arc lamp is making relatively greater strides than the direct current lamp just at this time. Perhaps our lamp and carbon manufacturers can shed some light on the subject, as indicated by their sales' books.

SOUND ELECTRIC LIGHTING ENTERPRISES.

THESE have been days to test the financial soundness and endurance of every enterprise. Not only has the country gone through a prolonged course of depression and disaster, but in the hour of extremity there have arisen counsellors to prophecy that the way back to prosperity is to scale down indebtedness in the cheap dollar, and we venture upon another risky economical experiment as eagerly as though there had not been enough lately to last an industrial people through one generation.

The ordeal of hard times has perhaps been hardest for new and young industries like the electrical, which in the period of easy money have invited large expenditures only to find that the moment of their maturity is beset by contraction of trade, lack of confidence, and general uneasiness or suffering. That electric lighting and railway companies have come through so well is striking, but to judge the profitableness of a young Florida orange grove just after a uniquely hard frost had nipped it, would scarcely be fair; and electric light and power plants, like such groves, still have their best years ahead of them, when conditions will be more favorable and when better methods have increased their capacity and productiveness.

That such is the opinion of very competent judges is evidenced by the recent financial operations of the Chicago Edison Company, noted recently in the newspapers and now confirmed by President Insull on his return from England. The facts are simply remarkable, and are full of encouragement. The company has made a $6,000,000 issue of mortgage bonds, at 5 per cent. gold, running 30 years, but redeemable at par, at the company's option in 15 years. The issue this year is $3,500,000. The company has outstanding at the present time $2,500,000 at 6 per cent., which will be exchanged for the new in part, a small amount being taken up and paid off in cash. Mr. Insull while in England sold $1,200,000 to a syndicate of London bankers, at a price just around par, their intention being to issue these bonds on the London market. The remainder of the bonds will be used from time to time as the Chicago business grows, and we presume that the same parties have first call on them.

This London sale is the more noteworthy in view of the fact that almost all of our securities have been in utter disfavor abroad because of the silver agitation; and another noticeable thing is that they were sold direct, without the intervention of New York, or even of Chicago, banking houses. The reason must be looked for in the belief in Mr. McKinley's election, and perhaps equally in the high class of the security, the net earnings above all operating expenses being, we have understood, more than three times the total interest charges of the $3,500,000 now being placed, or exchanged. The expert report on the company's system came from the careful hands of Mr. H. A. Foster, and the financial report was made by Price, Waterhouse & Company, the celebrated London accountants.

We have secured these details because, as we have said, they are full of encouragement for everybody who is doing good work in the electric lighting field, and who, rather than flouting foreign opinion, likes to see this country stand high in the esteem of the world. We have by the way, heard pessimistic sentiments as to the future of Chicago, whose financial troubles, postponed by the Columbian Fair, have been none the less stringent and severe in the long run; but here is well-founded evidence of belief in her continued growth and great future. Moreover, we must infer that with returning conditions of prosperity under a sound money regime, European bankers will realize that some of the "best things" are relatively small local securities in America, of this character. Such securities are, we imagine, practically unknown to-day in a market like London, which nevertheless absorbs similar securities from all over the world. The price is to us, little short of astounding; and if a higher price has ever been paid by a syndicate for a block of electric lighting bonds in this country, we shall be very glad to record it.

LITERATURE.

JULIUS CAHN'S OFFICIAL THEATRICAL GUIDE.—By J. Cahn, Empire Theatre Building, New York. Cloth, ill., 600 pages. Price, $1.00.

This is a most useful and interesting directory, one of the best we have ever seen. It gives each city, with its population, newspapers, hotels, etc., and a great mass of data in regard to the staff of each theatre, size, and other details. We are glad to note that a great number of theatres now have an electrician on the rolls and have large plants to be looked after; in fact, electricity is one of the most important adjuncts. The type is clear, the paper good, the arrangement of the information helpful and clear, the book as a whole very handsome. Its mere business contents are relieved by some fine portraits of theatrical stars, pictures of theatres, and railroad maps. The cover is strong and ornamental. Altogether Mr. Cahn is to be heartily congratulated on his first issue, which leaves only one thing to be desired—the next.

THE X-RAY. By Dr. W. J. Morton and Edwin W. Hammer. New York: Am. Technical Book Company, 1896. Illus. 196 pp. 12mo. Paper, 50 cents; cloth, 75 cents.

This unpretentious but striking book is one more proof of the intense interest felt in the discovery made by Prof. Röntgen. No other scientific pheunomenon has ever aroused so much immediate curiosity or been followed by so much immediate repetition of the experiments. In the present instance the value of the book is enormously enhanced by the fact that its chief author writes on the subject from the inside. Dr. Morton has not only been a zealous and alert student of electricity all his life, and a pioneer inventor in many of its fields, but in his application of electrical methods to his own profession he has been brilliantly successful, standing foremost to-day among the elctro-therapeutists of the world. It is obvious that the X-ray would make an irresistible appeal to one who is alike an expert electrician and a skilled physician, and it is matter of history that Dr. Morton was the first man in this city—perhaps in America—to test the Röntgen discovery. Since that time, his own work with the ray has attracted universal attention and his wonderful loan exhibit of cathodographs at the Electrical Exposition in May was a center of attraction to all, the praise of such men as Mr. Edison being the heartiest. This book, therefore, records Dr. Morton's own observations, studies and theories, in simple language, and throws out any number of valuable ideas as to uses in surgery and physiology. The accompanying "halftones" of his cathodographs, printed on plate paper, cannot be too highly commended.

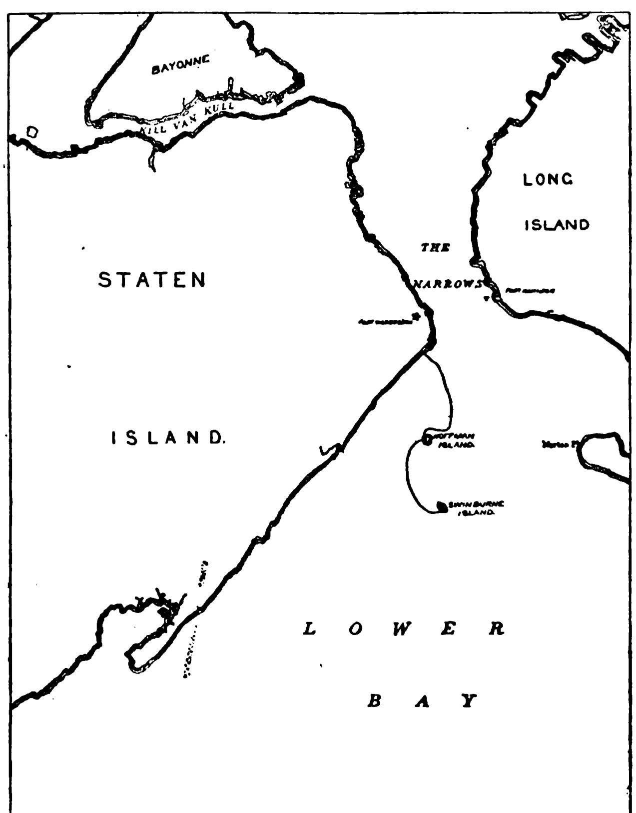
It was felt, however, that as this book would fall into the hands of many people not familiar with electricity, some useful information might be imparted leading up to the methods of producing the ray. Here Mr. Hammer's aid has been judiciously applied, and thus as the result of the collaboration the introductory part of the book serves as a very handy little guide to electrical principles and facts. There is also much that is pithy and pointed in regard to the bearings of photography on the subject. The book is quite handsomely got up.

TELEPHONY AND TELEGRAPHY.

THE NEW YORK QUARANTINE SUBMARINE TELEPHONE SERVICE.

ONE of the most important and interesting of the telephone services recently installed is that which is intended to meet the necessities of the quarantine system of New York City, as now established on Swinburne and Hoffman Islands at the entrance to the Harbor, in the Lower Bay. By means of the submarine cable and the telephone, these islands are now in communication with the mainland, so that not only the local quarantine headquarters can be reached directly and instantly, but any part of the country within the network of the Bell long distance telephone wires.

Few citizens of the city of New York, in fact very few citizens of the State of New York, are familiar with the situation and purposes of these islands, occupied by the State Government for quarantine purposes, situated as they are in the Lower New York Bay, almost, one might say, in the Atlantic ocean. These islands were, until a quite recent date, completely isolated from the world in general, no communication being had with the mainland except by steam vessels under the special control of the State Commissioners of Quarantine.



ROUTE OF CABLE CONNECTING HOFFMANN AND SWINBURNE ISLANDS WITH STATEN ISLAND, NEW YORK HARBOR.

After the experience of a few years ago with the importation of cholera, the Commissioners of Quarantine busied themselves with the improvement of the islands, and the service in general. Finding great advantages would be had by being in a position to have instant communication with the various officers in charge of Hoffman Island, devoted to detention and the examination of the suspected cases arriving from foreign ports, and with the officers in charge of Swinburne Island, devoted to the hospital service for the treatment of such cases as may have developed of a contagious or infectious nature, they decided upon installing a telephone system which would give direct connection with these islands.

After deliberation, the commissioners, seeking to obtain the best system possible, submitted their requirements to the manufacturer of Kerite cables, requesting that a plan be submitted whereby these islands might be connected one with the other, and with the mainland, by submarine cables sufficient to give them a service which would make instant communication possible between the islands and mainland, with the Health Physician's Office, situated at Quarantine Station, Staten Island, with the Commissioners' Office, situated in New York City, and with the State Government Office, at Albany, New York, together with such points as might be deemed necessary to reach by long distance telephone throughout the State.

After careful survey of the water surrounding, and the demands which would be made upon the cable for the purposes mentioned, the Kerite people submitted plans which were accepted, manufacturing and successfully placing in position special submarine telephone cables between the islands as mentioned and the mainland. The entire length of cable required is approximately 3½ miles, constituting one of the longest, if not the longest, submarine telephone cables (considering the capacity which is now in service) in the United States.

These cables having been successfully laid, were placed in connection with the system of the New York & New Jersey Telephone Company, giving private metallic circuit between Swinburne Island and Hoffman Island, Swinburne Island and Quarantine Station on Staten Island and trunk line, Swinburne Island to the central station of the N. Y. & N. J. Tel. Company at Tompkinsville, Staten Island, also Hoffman Island private metallic circuit between Quarantine Station, Staten Island; and trunk line service with central station N. Y. & N. J. Tel. Company at Tompkinsville, Staten Island.

This installation with the connections having been tested, was found to be remarkably perfect, and to give the most satisfactory service, reflecting great credit upon the foresight of the present Commissioners of Quarantine, upon the manufacturer of the Kerite submarine cables, and upon the N. Y. & N. J. Tel. Company, whose officials took active interest in aiding to make the installation one of the most perfect in this section.

The situation of the islands, together with surrounding waters showing the route taken in laying of cables will be observed in the cut accompanying this article. It is evident that in case of emergency, the islands are now in a position to summon immediate advice or assistance; while in case of contagious or infectious disease, the necessity to touch the shores of the two islands, or even approach them within hail, is reduced to a minimum.

ALLEGED SUBMARINE CABLE INTRIGUES RELATING TO SOUTH AMERICAN SYSTEMS.

THE project to connect the United States with Hayti by a direct line of telegraphic cable, in which John W. Mackay and others are interested, is in danger of interruption in consequence of a suit brought by order of the United States Attorney General. A bill of complaint was filed by United States District Attorney Wallace Macfarlane in the Federal Circuit Court in this city last week.

The suit is brought against La Compagnie Française des Cables Telegraphiques, the United States and Hayti Telegraph and Cable Company, and the United States and Hayti Cable Company. The complaint covers forty typewritten pages, and it alleges that the defendant companies are combining and conspiring together for the purpose of monopolizing a part of the trade and commerce between the United States and the several States thereof and foreign nations, to the irreparable injury of the people and business interests of this country.

An injunction is asked to prevent the defendants from carrying out their alleged unlawful agreement and from establishing their connecting cables on the shores of the United States. Part of the work of laying the cable between this country and Hayti, it appears, has already been accomplished. The American end of the cable starts from Coney Island. For the purpose, it is alleged, of laying a few miles of cable from Coney Island out to sea, where it could be connected with the West Indies and South American cable system, a corporation was formed, in February, 1895, entitled the United States and Hayti Cable Company. The charter was procured in West Virginia, and the stated capital is only $10,000. The incorporators named were John W. Mackay, George G. Ward, Albert Beck, John W. Mackay, Jr., and Albert B. Chandler.

Ten miles of cable were laid from Coney Island about July 9, 1895, and then the United States and Hayti Telegraph and Cable Company was organized under the laws of this State, the nominal capital being $1,800,000, and the incorporators Albert B. Chandler, Albert Beck, John Beattie, Edward C. Platt, John W. Mackay, and George Clapperton. The purpose of this company is believed to be to build a telegraph line

from New York City to Coney Island and to connect there with a cable to Hayti. Wires from this city extending through Connecticut, Rhode Island, Boston and other points on the coast of Massachusetts were provided for.

In the complaint filed last week the details of the alleged cable conspiracy are traced as follows: La Compagnie Française des Cables Telegraphiques is the successor in interest of companies heretofore known as La Compagnie Française du Telegraphe de Paris a New York, La Societe Française des Telegraphes Sousmarins, and of other French companies in the ownership of certain transatlantic cables between the United States and France, and of certain submarine cables in and between several islands of the West Indies, known as the Antilles, and of other lines of cable extending from these islands to several South American countries.

La Compagnie Française des Cables Telegraphiques owns a system of submarine cables starting from Santiago de Cuba and running thence to Hayti, San Domingo, Martinique and Guadeloupe, in the West Indies and thence to Dutch Guiana, French Guiana, and Brazil, in South America, and also a direct line from the Island of San Domingo to Venezuela. These cables have been laid, and are owned by La Compagnie Française des Cables Telegraphiques under concessions from the various countries, giving the company sole and exclusive right to land and to operate them between those countries and the United States for periods of from twenty-five to sixty years from the dates of concessions, which were granted between 1888 and 1890. By reason of these concessions no American countries or citizens are permitted to land lines of submarine cable in those countries.

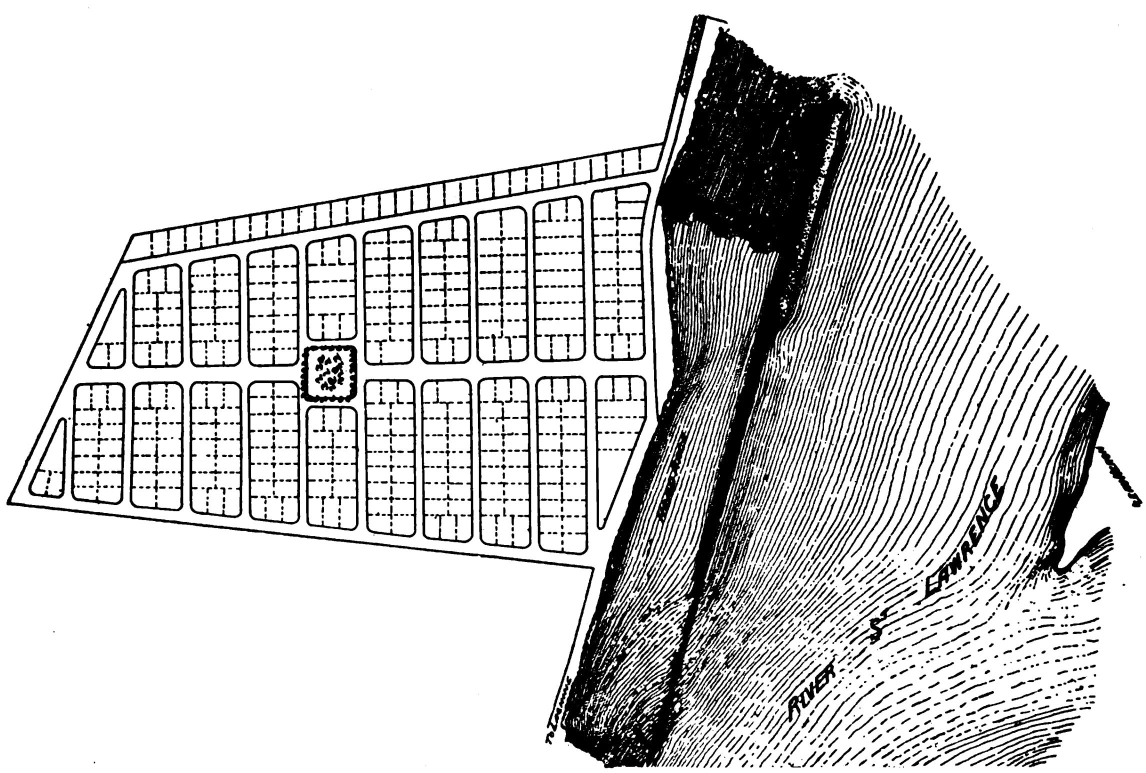
This French company is to receive for thirty years a subsidy of 800,000 francs per annum from France. For several years efforts have been made by this company and its predecessor to land a cable on the shores of the United States, but this Government refused to grant permission, except on condition that the French company surrender its monopoly between the United States and the islands and South American countries. For the purpose of evading this condition, it is charged in the bill of complaint, La Compagnie Française des Cables Telegraphiques entered into an unlawful agreement with the other defendant companies to secure direct communication between the United States and the West Indies and South American system of cables. The two American subordinate companies, it is asserted, were formed expressly for the purpose of enabling the French company to connect with our shores, and at the same time fulfill its special and monopolistic contract with the French Government.

It is further alleged that the French company had chartered two ships, one of which, the François Arago, has laid the shore end of the connecting cable off Hayti. The other vessel, the British steamer Seine, is now ready to make a connection with the Coney Island cable, and it is asked by the complainants that an injunction be speedily granted.

Power Transmission.

ELECTRICAL TRANSMISSION OF POWER FROM THE LACHINE RAPIDS TO MONTREAL.

The commencement of the second largest electrical plant in the world was successfully begun at Montreal, Canada, on Saturday, September 12. The harnessing of the Lachine Rapids of the great St. Lawrence River has been a work to which some of the first engineers of Canada have given their best days, but the great obstacles that nature has placed in the way, together with the lack of sufficient capital to carry out the immense project, have up to the present time proved insurmountable. As far back as 1867, a company known as the St. Louis Hydraulic Company was formed by the late James Key Springle, C. E., of Montreal, but the country was too young and not sufficiently advanced to admit of the accomplishing of the great work. At that time the English press remarked that the men who successfully carried out the scheme would be ranked among the greatest engineers of the age. When it is considered what immense power lay dormant in the St. Lawrence, it cannot be wondered at that several of the prominent capitalists of Canada, observant of what had been done in other water power plants, immediately came to the front with their financial backing, when the scheme was again prominently brought before the public in the summer of 1895. After the usual formalities had been gone through the needed permits had been received from the Canadian government, a meeting was called and on the 15th of July, 1895, the first subscription to stock was taken. At the present time $1,110,000 has been subscribed by twenty-two stockholders, of which $800,000 has already been paid in, the best evidence of faith both in the engineers and in the enterprise.



Electrical Power Development, Lachine Rapids, Montreal, Can.

The work, which might be called the making of an artificial canal, is situated on the north shore of the St. Lawrence, right upon the Lachine Rapids and about five miles from Montreal. The wing dam is constructed of crib-work filled in with boulders, with a cutstone ice fender at the upper end and triangular piers sunk at six feet below water to take up the fall that exists above the head-race. The greatest obstacle to overcome has been the action of anchor and "frazil" ice, the bugbear to all who have to do with water powers in Canada. The engineers have made a careful study of all of the surround-

ings since 1875, determining the bed of the rapids, the velocity of the water and the records of the state of the river. They have now, it is believed, adopted a course in constructing the dams and head-race which will be satisfactory and free from this trouble. Frazil ice is never known to form in still water or under ice; as the head-races will freeze over during the winter, no frazil will be formed in it. The dams and head-races have been formed so as to take advantage of the fact that the ice when it gets into still water will float to the surface, and consequently the power utilization will not suffer from it. Owing to the peculiar formation of the shore and the position of the dam in regard thereto the current tends to strike the dam at an angle and with great velocity, due to the rapids above. The water approaches the head-race at a very great velocity and continues thus over the overflow of the dam, carrying with it the floating anchor ice. A sort of water dam is formed at the intake, owing to the water moving into the head-race at a slow speed, creating no suction and carrying no anchor ice with it.

The main dam of the work running out from the shore consists of a series of isolated piers of masonry and concrete, and is constructed about 3,500 feet down stream from the ice fender. The piers are made to form the flumes to take the turbine wheels and shafting which generate and deliver the power. The sixty turbines will operate under a head of 12 feet and will develop 200 h. p. each, making a total of 12,000 h. p. all the year round. There are three power houses in which will be located the electrical generators, four in each power house, each of about 1,000 horse-power. These generators are coupled to a jack shaft, and six of the turbines are connected to this shaft with bevel cone gears, thus transmitting to each generator the power of six turbines, or 1,200 h. p. The building extends the full length of the main dam, and is 42 feet wide, excepting at the power houses, where it is 60 feet. The construction is of steel and each power house is to be equipped with a traveler which runs from end to end of the building. The original idea of the company was to generate the power merely and dispose of it on the jack shaft, and to lay out a large portion of the adjoining grounds into factory sites. During the winter, however, it was decided to bring the power into Montreal and dispose of it there. The capital was increased on this decision from $1,000,000 to $2,000,000, and a controlling interest was secured in the Citizens' Light and Power Company, which has valuable franchises, in order to receive an entrance into the city.

The contract for water wheels and hydraulic machinery is in the hands of the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio, who have already delivered thirty-eight carloads of machinery. In order to distribute wires in the city underground, a contract for some 500,000 feet of cement-lined iron pipes has been awarded to the National Underground Conduit Company of New York, who are endeavoring to complete their work before the frost comes. The contractors for the main work are William Davis & Sons, of Ottawa.

The opinions of the most expert engineers in Canada have been obtained by the company and they, one and all, have indorsed the statements of the company's own engineers. By the first of the new year the entire work on the immense construction will have been concluded and the power brought into the company's house in Montreal, where already the chances of better and cheaper lighting and power are being looked forward to with very lively interest. In addition to the great development of water power, the Lachine Hydraulic and Land Company have decided to lay out their property adjoining the work in the form of a model town. The property will be divided into building lots, drained, graded, supplied with water, electric lighting and electric heating, besides having its own electric railway to Montreal. The engineers and promoters of this greatest enterprise of its kind in Canada are W. McLea Walbank and Thomas Pringle & Son, of Montreal, and to their ability and efforts is due the success of the undertaking, as far as it has gone.

CALIFORNIA MINES.—It is said by "Harper's Weekly" that electricity has made a great change in mining in California, where there are now 800 more mines at work than in 1895, the number now being 2,411, employing 18,410 men. Only a few years ago no ore which assayed less than $10 a ton could be worked with profit; now $4 ore may be made to pay if water power is near and abundant. "Electricity gives the greatest aid to the miner, for it permits him to carry power over mountain canyons, and to work mines which were formerly inaccessible."

H. M. LA FOLLETTE, an ex-Congressman, has been arrested on the charge of selling by fraudulent representation 122 bonds of the Connorsville Gas and Electric Light Company, a concern formely owned by J. N. Huston, treasurer of the United States.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.[1]—I.

BY DR. LOUIS DUNCAN.

It is my purpose to take up the different methods of transmission and distribution and to consider the limits that are actually fixed by the present status of electrical development. The question is a commercial one, each problem presenting different conditions which must be considered, but certain general principles govern each case, and our knowledge and experience makes it possible to judge the practicability of each particular transmission.

GENERATING PLANTS.

At the present time practically all of the electrical energy distributed is generated in plants operated either by steam or water power, and it is important to consider the conditions of maximum economy in large generating plants, as this bears directly on the subject of transmission and distribution.

Some of the latest steam plants have machinery of the highest possible efficiency, and yet if we consider the price per horse-power of the power generated, we will find that it is greater than we expect. This is partly due to the fact that for both lighting and power purposes the load on the station, is, as a rule, not uniform and the apparatus is not working under the best conditions for economy. If we take the load diagram of such stations in large towns, we will find that the average output is not greater than 30 to 40 per cent. of the maximum output. We have, therefore, to supply a large amount of machinery corresponding to the maximum demand on the station, while for distribution a large amount of copper is required that is only being used at its maximum capacity for a comparatively short period of the time. In stations supplying power for traction purposes we find a variation of load, but the variation is a different kind from that found in a lighting station. In the latter the load varies at different hours in the day, but for any particular instant it is practically constant. In the former the average load for different hours during which the station is operated will be practically constant, but there will be momentary variations depending upon the size of the station and the type of traffic. Taking for instance a 2,000 horse-power station in Baltimore, I find that the average load is 48 per cent, of the momentary maximum load. This difference in the kind of variation for the two types of stations necessitates employment of different apparatus to obtain the maximum economy for each type. For lighting stations triple expansion engines may be used, while for traction work, where the variation in the load is sudden and may occur after the steam is cut off from the high pressure cylinder, it is not well in general to go beyond compound engines, and there is even a question as to whether simple engines are not more economical when condensing water cannot be obtained. In any case, however, it is of the utmost importance as regards economy of operation that the load should be made as constant as possible.

Two distinct types of distribution are used for incandescent lighting in this country—the single-phase alternating current and the direct current three-wire system. At the present time the former does not permit the supplying of power.

With the alternating system it seems impossible to provide even a moderately steady output, but with the continuous current system the motor load during the day gives an average output greater in proportion to the maximum. Some years ago the question of the relative values of the alternating and direct current systems was discussed, and for a while most of the stations installed were of the alternating type. At present the tendency seems rather in the direction of continuous current stations, especially in towns where there is a large demand for current within a comparatively small area. There is a great advantage of direct currents in that they allow the employment of storage batteries, which equalizes the load on the station. The efficiency of batteries in lighting stations is comparatively high, while the depreciation has been greatly reduced, and is not now over five or six per cent. per annum. In most systems, however, the full benefit of the storage batteries is not realized, as the batteries are placed in the station, and while the advantage of an approximately constant load is obtained, yet the further advantage offered in distribution is not secured. I will take this question up later.

As far as traction stations are concerned, their efficiency and output would be increased by the use of batteries, both because the machinery would be steadily loaded and because the most efficient type of apparatus could be used, as is the case in lighting stations.

If storage batteries are used the two types of variable load belonging to lighting and power stations demand different

[1] Presidential inaugural address read before the American Institute of Electrical Engineers, Sept. 23, 1896. Abstract.

types of battery. For lighting stations a considerable capacity is required,, while the momentary variations of power stations do not require any great capacity, but demand as great a maximum output as battery manufacturers can obtain.

In water power plants the conditions of economy are different. The location of the plant is, of course, definitely fixed, and the advisability of obtaining a uniform load, by means of batteries, depends upon the local conditions.

We may conclude that while the practice in large lighting and traction systems is to multiply stations near centres of consumption, yet the economy of a single large station makes it important to consider whether it is not possible to concentrate our power at some point where the expenses will be a minimum and distribute by some of the methods which have in the last few years proved successful and economical. It is important to make the station load steady, and this may be done for continuous current lighting and traction plants by means of storage batteries.

ELECTRICAL DISTRIBUTION.

I shall first consider the condition of affairs in a traction system in a large city, where a number of suburban lines are operated. If direct distribution is attempted from a single station, it will be found that when the distance exceeds five or six miles a large amount of copper must be employed to prevent both excessive loss and excessive variation of potential on the lines. On suburban lines it is the latter consideration that usually determines the amount of copper used, and this is especially true on lines where there is a considerable excursion traffic. Even in the city itself, the supplying of sections at distances three or four miles from the station may require so much copper that it would be less expensive to operate separate stations. Several methods other than the direct method may be employed to remedy these difficulties. For outlying lines where the traffic is mainly of the excursion order, being variable both during the day and for different seasons, boosters may be advantageously used. It is perhaps best from reasons of economy to run the boosting dynamos from motors. If the average station potential is 600 volts, and it is boosted 300 volts, then the copper for a given loss would be decreased in the ratio of 36 to 81. The booster system has the advantage of the direct system when the cost of the additional apparatus together with the increased loss on the line, capitalized, is less than the increased cost of the copper necessary to produce the same result by the direct system. Whether the balance is in favor of one or the other depends on the distance and the variation of the load, and it is indifferent whether the variation in the latter occurs often or not.

If any transforming device is employed to feed a distant section of the line it must be remembered that the capacity of the device must be great enough to look out for the maximum demand on this section. Suppose now that we wish to feed some suburban line where the load has considerable momentary fluctuations but where the traffic is moderately constant during the year. In this case the booster could be used with a storage battery at the end of its feeder, the battery supplying the line. The advantages of this combination are greater than with the simple booster and in many cases they will compensate for the interest and depreciation on the battery and the loss in it. If the arrangement is properly made, the load on the booster and line wire will be practically constant, thus decreasing the capacity of the booster to that required for the average load, while less copper will be required for a given loss. As to the latter point, suppose a given amount of power is to be distributed in 24 hours, say, 200 amperes at 600 volts; if the load is uniform, the loss will be proportional to $200^2 \times 24$ hours. If it is all distributed in 12 hours, the loss will be proportional to $400^2 \times 12$ hours, or twice as much. So in the case of the steady load the same power could be transmitted with the same loss with half the copper. It makes no difference whether the variation extends over 12 hours in 24 or it occurs every other minute, the result will be the same. It is apparent then that it is of the utmost importance to keep the line steadily loaded, as well as the station, and this points to the location of the battery near the points of consumption and not in the station. By this system—a booster with storage batteries—it is possible, assuming the same loss, to transmit power to a distance of ten miles with approximately the same amount of copper that would be required for a five-mile transmission on the direct system. It would increase the economical radius of distribution twice and the area of distribution four times. A single station could economically supply lines within distances up to ten or twelve miles. If it is desired to still further increase the radius of distribution, it is possible to do this by employing some of the alternating current methods that have come into use. I will discuss these methods later, but at this point I may remark that the use of stationary and rotary transformers permits the energy to be transmitted in the form of alternating currents, and to be changed again into continuous currents of any required voltage. These rotary transformers supplied by an alternating current which is transmitted from the station at a high voltage, may be used to feed the line directly or they may be used to supply storage batteries which are connected to the line. In the latter case we have the advantage of decreased size of apparatus, of steady load on the station, and of a minimum cost of copper on the line; which system it would be best to employ would depend upon the distances and the character of the line and load.

Of the systems that I have proposed for city and suburban distribution from a single station, three have been successfully employed, namely: the booster system; the booster system with batteries and rotary transformers operating directly on the line. When we consider the advantages of a single station and a steady load, it seems evident to me, that many of the large traction systems would do well to concentrate their stations into one and to use the booster system with batteries for their outlying lines, and if necessary use rotary transformers for lines beyond the limit of ordinary suburban work.

MISCELLANEOUS.

COUNTER E. M. F. IN INDUCTION MOTORS.

BY PROF. HENRY S. CARHART.

THE conception of a counter electromotive force in a direct current motor is an essential one, for this counter electromotive force is indispensable to the action of the motor. It may almost be said that the function of the armature is to generate counter electromotive force. Without it no power can be obtained from the motor; and the measure of the electrical energy, converted into mechanical work by the motor, is the product of the back electromotive force and the current flowing through the armature.

Now while counter electromotive force in an induction motor is quite a different thing from this reactive electromotive force in a direct current machine, it will still be a useful exercise to trace out the analogies between the two. Any mode of treating a new or unfamiliar piece of mechanism that brings out the similarities to what is already familiar, in so far helps to an understanding of the newer device.

Consider, first, the case of an induction motor with a rotating field. If Ω is the angular velocity of the rotating field and ω that of the rotor, then the current and the torque are both proportional to $\Omega - \omega$ the slip. It is evident that the induction in the rotor is precisely the same as if the field stood still and the rotor were turned backward with the angular speed equal to the slip. If the speed of the rotor is the same as that of the field, then there is no induction in the rotor coils; if the rotor speed exceeds that of the field, then the induction is again the same as with a slip of equal value, but opposite in sign, and the motor becomes a generator. If W is the watts applied to the rotor, w the useful watts, and T the torque, then we may write $W = T\,\Omega$. and $w = T\,\omega$. Hence the efficiency is $w/W = \Omega/\omega$. The efficiency equals the ratio of the two speeds.

Now in a direct current motor the efficiency measured electrically is the ratio between the counter and the applied electromotive forces. It will be observed that when there is no slip there is no induction in the rotor. This is exactly equivalent to saying that then the counter electromotive force generated by the rotation of the rotor is equal to the electromotive force generated by the rotation of the field. And, in any case, when the slip has a definite value, the induction in the armature is less than it would be if it stood still, by a quantity proportional to the speed of the armature. In other words, there is a virtual counter E. M. F. exactly equal to that which would be generated if the field stood still and the rotor turned forward with the speed, ω. The back E. M. F. may, therefore, be said to be proportional to the speed of the rotor, and the E. M. F. applied to the rotor is proportional to the speed of rotation of the field. Hence the electrical efficiency is the ratio of the back E. M. F. to the total applied E. M. F. as in the case of a direct current motor.

Again, consider the case of a monophase induction motor. If the field is uniform or symmetrical the motor is not self-starting. But if the resistance of the rotor bears a certain relation to the self-induction, then when the rotor is given a good start it will continue to increase its speed up toward synchronism and will exert a large torque. Evidently when the rotor is turning, the currents in it must be less than when it stands still, with the same current through the stator coils. If the rotor is driven up to synchronism, then no currents will be generated in it, and there will be no torque. If the speed be increased beyond synchronism, induction will again take

place and the machine acts as a generator. The back E. M. F. then becomes greater than the direct E. M. F. of the system. Evidently then the rotation of the rotor in an alternating field produces what may with propriety be called a counter electromotive force. This E. M. F. generated by the rotation of the short-circuited coils in the alternating field reduces the currents flowing as in the case of the rotary field motor.

In one important respect back E. M. F. in an induction motor differs from the counter E. M. F. of a direct current motor. Since the armature in the latter is in series with the external circuit, the back E. M. F. acts directly to reduce the flux of electricity in that circuit. But in the induction motor the stator coils are entirely distinct from the rotor coils. It is very easy to see, however, that any reduction of current in the rotor by a real or a virtual counter E. M. F., due to the rotation, operates to reduce the current in the stator coils as well. For an induction motor is only a transformer with the secondary so arranged as to be capable of rotation. Now a stationary transformer is self-regulating. On open secondary, the primary acts simply as a choking coil; but when the secondary is closed, the current flowing through it operates by means of the mutual induction between it and the primary, to increase the primary current. Conversely, a decrease in the secondary current causes a decrease in the primary. The same mutual reaction takes place between the rotor and the stator in an induction motor. When the rotor current is reduced by means of the back E. M. F., due to the rotation, the reduction in the mutual induction between it and the stator, causes the latter to act more like a choking coil, and the virtual current through the stator is also reduced. In the primary or stator coils the counter E. M. F. is strictly the E. M. F. of self-induction. The mutual induction resulting from the secondary currents reduces or offsets the E. M. F. of self-induction. Of course, the difference of phase must be taken into account, but the general action is as described.

It will be seen, therefore, that it is quite possible to draw some strong analogies between induction and direct current motors in respect to the counter electromotive forces generated by the rotation of the coils of the rotating member in a magnetic field.

ELECTRICITY IN NAVAL LIFE.—III.

BY LIEUT. B. A. FISKE, U. S. N.

TELEPHONES.

The telephone is gradually making its way against the speaking tube. The latter has the advantage of simplicity of principle, the telephone of distinctness. The speaking tube is less apt to get out of order; the telephone does better service when it is in order. The speaking tube is more difficult to lead through the devious labyrinth of the compartments and it occupies valuable space, and while the telephone is not difficult to keep in order, the connecting wires sometimes get disconnected. The telephone has not as yet had a fair chance on shipboard because it is comparatively recently that the long-distance "solid back" transmitter has been introduced. So far as the writer's experience goes, the persons who are not acquainted with this telephone prefer the speaking tube, while those persons who are acquainted with both prefer the telephone.

The principal disadvantage of the telephone for military use is one that it possesses in common with the speaking tube, that is, that it is a very inefficient instrument when used by a person under excitement. With both the speaking tube and the telephone clearness of articulation and a voice not too loud are necessary, if the message is to be quickly and unhesitatingly understood at the other end, and men under excitement are sure to speak loudly and not very distinctly. For the transmission of orders, therefore, and for signaling to the engine rooms, helm and guns, visual indicators are coming into use. Visual indicators possess, besides the advantage of distinctness, the additional advantage that they do not add to the noise on shipboard and are not affected by it, and that the message which they bear remains in evidence until it is replaced by another message, so that "the last order" can always be referred to by a glance of the eye.

The writer has been engaged for some years in perfecting a system of electric apparatus for use in ships and forts which has of late emerged from the experimental stage and seems to contain the possibility of considerable usefulness. Most of this apparatus is based on a central principle of construction which aimed to avoid the inherent difficulty of previous electrical apparatus when used in or near sea air. This difficulty was apparently a trivial but really an almost insuperable one; the sea air attacked and corroded the metallic contacts with which the apparatus was filled. In nearly, if not all, the electrical apparatus used for signaling, the mechanism consisted of a train of wheels which were moved by a pawl and ratchet; the pawl and ratchet being moved, in turn, by an electro-magnet which pulled the ratchet wheel down one tooth every time the current was made and broken. Even the simplest mechanism made on this plan contained many parts, most of them small, and the greatest care was needed to keep everything in order. The only safety lay in hermetically sealing the cases, and this was far from satisfactory and made the mechanism inaccessible. In endeavoring to find a way out of the difficulty, the writer conceived the idea of using only unbroken circuits, which were varied in strength by gradual variations and never by jumps, the variations being indicated by galvanometers and attained by the moving of a wiper over a continuous wire of high resistance. And, as any general discussion of the subject of electricity in naval life would be incomplete if it omitted to mention the labors of even the humblest worker in the field, the writer feels emboldened to introduce to the Institute certain efforts of his own which, with two exceptions that will be designated, have passed official tests in service and are now in use in some of the new ships and are to be installed in others. Beginning with the simplest he respectfully presents the Helm Indicator.

ALTERNATE CURRENT TRANSFORMERS.—VIII.

BY DR. J. A. FLEMING.

With regard to the high pressure cable, it is customary to use ordinary duplex concentric cable, and if the service is a 2,000 volt service, then after the cable has been laid in the ground it should be tested by a pressure of 4,000 volts placed between the inner and outer members for one hour, and a pressure of 2,000 volts between the outer member and the earth, and the cable should not be accepted unless it has passed this test. As it is always desirable to use concentric cables in connection with all modern transformer systems of distribution it is necessary to pay attention to some peculiar effects which are observed in connection with concentric cables when supplying transformers, and during the remainder of the lecture I propose to occupy your attention chiefly with practical points connected with these effects. They may be divided into four classes. There are, first, those which may be called the resistance effects, which are effects connected with the distribution of the current over the cross-section of the conductor employed for the transmission of the alternating current. Secondly, there are the capacity effects, which depend upon the fact that a concentric cable is a large condenser or Leyden jar. Thirdly, there are the resonance effects, which are due to the reaction of this capacity upon the alternators, or the primary transformers. Fourthly, there are effects which may be called the initial stage effects depending upon the capacity of the cable, and the inductance of the transformers supplied through it, both of which co-operate together to produce peculiar effects at the moment when the cable carrying the transformers is switched into connection either with another live cable or with an alternator. We shall consider each of these in turn. It will be necessary to preface a detailed discussion of these effects by some general remarks upon the nature of current flow in inductive circuits. Every electric circuit which has self-induction or inductance and capacity has a natural period of electric vibration—that is to say, if the electric charge in it is disturbed, and then left to itself, it oscillates backwards and forwards as water would do in a long tube having the ends closed by elastic caps. In such a case, if the water was disturbed and then left to itself, it would oscillate to and fro in virtue of the fact that the mass of water possesses inertia, and that the elastic caps on the ends of the pipe permit the water to be displaced. In other words, such a closed pipe has what may be called hydraulic inertia and permittance. In the same manner, a circuit which has self-induction possesses what may be called electric inertia or inductance, and a condenser which permits of electric displacement to be made through its dielectric or non-conductor has what is called capacity or permittance. If a condenser with a capacity, C, is being charged through a resistance, having a value represented by R, the product, C R, is called the time-constant of that system, and it represents the time in which the charged condenser, if left to itself, short-circuited by the resistance, R, would fall in potential to a certain fraction (very nearly two-thirds of its original potential); again, if L is the inductance of a conductor and R its resistance, then $\frac{L}{R}$ is called the time-constant of that circuit, and this is the time in which a current in that circuit would rise to about two-thirds of its full value if a constant electromotive force is put upon the ends

of the inductive resistance. The first product, C R, is called the electrostatic time-constant of the condenser and resistance, and the quotient, $\frac{L}{R}$ is called the electromagnetic time-constant of the inductive resistance. If, then, we join together in series a condenser having a capacity or permittance, C, and an inductive resistance having an inductance, L, and a resistance, R, it can be shown that the complete, free, periodic time of oscillation of a charge of electricity in that system is given by this expression:

$$t = 2\pi\sqrt{\frac{L}{R}\,CR}.$$

In other words, the complete periodic time is equal to 2 π times the geometric mean of the electrostatic and electromagnetic time-constants. It must be noted that this is the time of oscillation of the charge when left to itself, but it is, of course, perfectly possible to make what is called a forced oscillation, and that is what is done in every transformer system. These electrical quantities have their mechanical analogues. Suppose, for instance, we take a pliable lath with a weight on it, and fix it at one end, the pliability of the lath is the analogue of the capacity of the electrical system, the mass of the weight on the end is the mechanical analogue of the induction of the system. If, then, we displace the lath, or bend it, and leave it to itself, it vibrates to and fro with a natural period of its own, in virtue of the fact that the system has pliability or permittance,

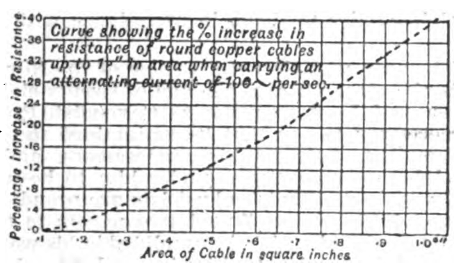


FIG. 48.

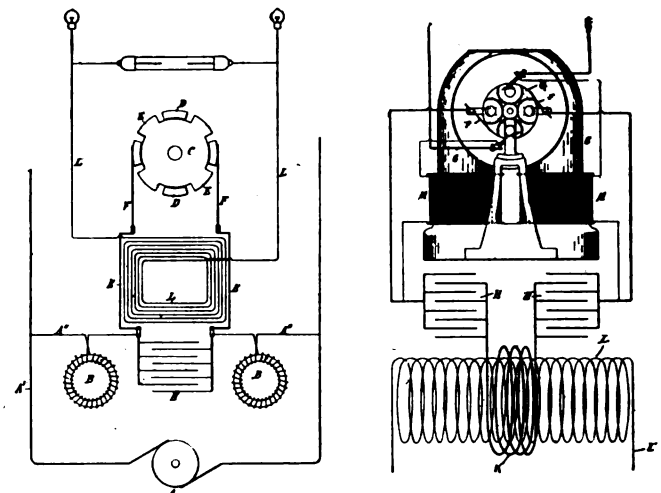
and mass or inductance. If the mass be small, and the pliability is small, the time of vibration is small; but if the pliability is great, and the mass is great, then the time of vibration is great. Such a loaded flexible rod not only has a free period of vibration of its own if fixed at one end and set in oscillation, but we may give it a forced oscillation. Before explaining the matter in which certain electrical effects may be mechanically imitated by such a loaded lath, we will consider a little more in detail the properties of concentric cables when used with alternating currents. In the first place, a cable intended for use with an alternating current must not have the metal or conductor of which it is made of a thickness exceeding a certain value, for the reason that a certain time has to elapse before the current is established in the central portions of the conductor, and, therefore, if the conductor is used with alternating currents, its actual resistance depends upon the frequency and the thickness of the conductor. Without going into more elaborate explanations on this point, for which I refer the reader to other text-books, I may give here a table showing the resistance of high conductivity round copper conductors to continuous and alternating currents of a certain frequency, the results of which are set out graphically in a curve in Fig. 48.

TESLA HIGH FREQUENCY APPARATUS OPERATED FROM LOW POTENTIAL DIRECT CURRENT CIRCUITS.

THE brilliant experiments in high frequency and high potential currents made by Mr. Tesla have been carried out by the aid of initial alternating currents raised from low to high potential. But in order to simplify the methods of work in this field, Mr. Tesla has devised a type of apparatus noted in our Patent Record last week, which enables currents of the desired high potential to be obtained from ordinary low potential continuous current circuits. In carrying out this scheme, Mr. Tesla employs a circuit breaker, around the contacts of which a condenser is connected, to store the energy of the discharge current; and in a local circuit and in series with the condenser he places the primary of a transformer, the secondary of which then becomes the source of the high frequency currents.

The accompanying diagram, Fig. 1, shows one form of the apparatus. The choking coils, B B, and circuit breaker, C, are placed in circuit with the continuous current mains, A. The circuit breaker is rotated by a continuous current motor. In parallel with the circuit breaker is the condenser, H, and in series with the latter the primary, K, of a transformer, the secondary, L, of which is the source of the high frequency currents.

Another, more convenient form of the apparatus is the arrangement shown in Fig. 2. In this case the motor, G, which



FIGS. 1 AND 2.—TESLA'S SIMPLIFIED HIGH FREQUENCY APPARATUS.

drives the circuit breaker, has its field coils in derivation to the main circuit, and the controller, C, and condenser, H, are in parallel in the field circuit between the two coils; the field coils, M, taking the place of the choking coils, B.

In this arrangement, and in fact generally, according to Mr. Tesla, it is better to use two condensers or a condenser in two parts and to arrange the primary of the transformer between them. The breaks of the field circuit should be so rapid as to permit only of partial demagnetization of the cores which should be laminated.

It will be apparent from a consideration of the conditions involved that were the condenser to be directly charged by the current from the source and then discharged into the working circuit a very large capacity would ordinarily be required, but by the above arrangement the current of high electromotive force which is induced at each break of the main circuit furnishes the proper current for charging the condenser, which may therefore be small and inexpensive. Moreover, it will be observed that since the self-induction of the circuit through which the condenser discharges, as well as the capacity of the condenser itself, may be given practically any de-

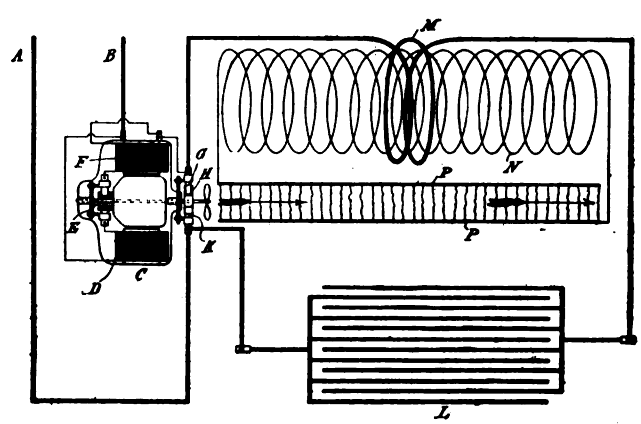


FIG. 3.—TESLA'S OZONE GENERATOR.

sired value, the frequency of the discharge-current may be adjusted at will.

Mr. Tesla has also devised a number of other methods for accomplishing the same object, which form the subject matter for a number of patents just issued to him.

Among the uses to which Mr. Tesla proposes to put the new arrangement is the generation of ozone in large quantities. The engraving, Fig. 3, shows the simple method employed for

this purpose. The high frequency brush discharge takes place between the metal plates, P P, and a current of air is forced between the latter by the fan blower attached to the motor that drives the circuit breaker.

PERSONAL.

PROF. J. J. THOMSON AND HIS WORK.

In view of the fact that Prof. J. J. Thomson, of England, will participate this month in the sesquicentennial exercises at Princeton and then deliver a special series of lectures on Electrical Discharges in Gases, renders of more than usual interest the accompanying biographical sketch, which we abstract from the London "Electrician," whose portrait of Prof. Thomson we also reproduce.

Prof. Thomson, the president of Section A, at the meeting of the British Association held at Liverpool, has advanced Physical Science in many directions, and especially in the direction in which the way was pointed out by Clerk Maxwell, his great predecessor in the Cavendish Chair of Physics at Cambridge.

Prof. Thomson was born at Manchester in 1856. Educated first at a private school, he entered Owens College at the age of fourteen. Thomson remained at Owens five years, and in his last year there he published his first paper; an experimental research showing that mere contact of two dissimilar bodies produces in them opposite electrifications, each of the

PROF. J. J. THOMSON.

same kind as that manifested when the two are rubbed together, and suggesting that the contact gives the polarization of which the friction enables us to take advantage.

On leaving Owens in 1876, Thomson entered Trinity College, Cambridge. In 1880 he graduated as Second Wrangler and obtained the Second Smith's Prize. In the same year he was elected a Fellow of his college, and later was appointed an assistant lecturer.

In Thomson's undergraduate years Maxwell still held the chair of Physics and his ideas and methods were now beginning to penetrate down to the undergraduate level, and to saturate the minds of all the more earnest students of Mathematical Physics. Naturally, then, we find that Thomson's first paper after his degree was inspired by his study of Maxwell's work. It was on the "Electromagnetic Theory of Light," and among other results he found that if light travels in a medium itself moving in the direction of propagation, the velocity is increased by half the velocity of the medium, a result already obtained experimentally by Fizeau in the case of water. Later, in his "Recent Researches," he returned to this point, and showed that the result obtained differs according to the preliminary assumptions made; and Prof. Lodge's experiments have sufficiently shown that the subject is still full of difficulties.

A year later, in 1881, this was followed by a paper investigating the motion of electrified particles in a magnetic field. He applied his results to the phenomena of a Crookes tube, assuming Crookes' explanation of a stream of charged atoms starting from the cathode, and he showed that the magnetic deflections observed by Crookes were of the kind given by his theory.

In the following years Thomson was occupied with a research on the value of "v," carried out in the Cavendish laboratory under Lord Rayleigh, and with investigations on vortex motion. These were published in the "Philosophical Transactions," and in 1883 he received the Adams Prize for an essay on Vortex Motion, a most important contribution to the subject. Applying the ideas of vortex motion to electrical theory, he began in 1883 his great work on the electrical discharge in gases by publishing a theory of that discharge on the supposition that a gas molecule consists of two vortex rings in a fluid strung on the same axis, and successively going through each other. The electric field he supposes to consist of some kind of distribution of velocity in the surrounding fluid. If the velocity is in one direction parallel to the common axis, the rings tend to separate, in which case he shows that there is a reduction of the velocity of the surrounding fluid; that is to say, the molecule tends to break up into separate atoms, and in so doing absorbs the electrical energy. The theory gives a reduction of pressure along the lines of force, and an increase at right angles to them, in accordance with Maxwell's theory.

In 1884 Thomson was elected a Fellow of the Royal Society, and later in the same year, at the age of twenty-eight, he was chosen to succeed Lord Rayleigh as Cavendish Professor. It is hardly necessary to say that he maintained the reputation conferred on that chair by his predecessors, and that the Cavendish laboratory continues under him to be a school of research of which all English physicists are proud.

In 1885 and 1887 he contributed two papers to the "Philosophical Transactions," which he amplified in his work on "The Applications of Dynamics to Physics and Chemistry," published in 1888. In the general methods of Lagrange and Hamilton any mechanical system is described not merely by distances, velocities and moments of the masses concerned, but by quantities analogous to these. Thomson applies their methods to a physical system in which the quantities describing the system are the ordinary quantities of physical measurement. By known results he obtains relations which must hold between these quantities, and then from the relations he obtains other results which may not hitherto be known. As an example, Ettinghausen and Nernst have found that if heat is flowing along a thin plate of an electric conductor placed in a magnetic field, there is an electromotive force perpendicular to the plane containing the lines of heat flow and the lines of magnetic force. This gives a relation which shows that if the effect holds also in a dielectric, then a heated dielectric placed in an electric field may produce a magnetic field. The work is a mine of suggestions for future research.

After the publication of Hertz's experiments Thomson made some notable contributions, theoretical and experimental, to the subject. Determining the resistance of various electrolytes, he showed it to be the same for the currents in Hertzian waves with a frequency of 10^8 as for steady currents. But if the electromagnetic theory of light is true, the electrolytes are perfect insulators for waves with a frequency of 10^{15}. Hence "the molecular processes which cause electrolytic conduction must occupy a time between 10^{-8} and 10^{-15} of a second." He also measured the specific inductive capacity of various dielectrics by making them in turn the insulator between the two plates of a Hertzian vibrator, and measuring in each case the length of the issuing waves. From this it is easy to compare the capacities. The values of K agreed with those required by the electromagnetic theory of light; and it is especially worthy of note that with a frequency of 25×10^6 the value of K for a glass plate was 2.7 or 1.65^2, practically the square of the refractive index for light waves; while for the same glass plate the tuning-fork method gave values between 9 and 11. "The discrepancy is probably due to the cause which produced the phenomenon of anomalous dispersion in some substances, and indicates the existence of molecular vibrations having a period slower than 25,000,000 per second."

Continuing the work on the discharge in gases, in 1890 Thomson showed that certain gases, when heated to the dissociation point, become good conductors, another link in the chain of evidence which he was gradually forming to show that the discharge is electrolytic, and that the dissociated atoms of a molecule are, the one positively, the other negatively charged. When the effect of heat is to break up the

molecule into atoms, the charges on the electrode may be regarded as neutralized by the charges on the dissociated atoms; or, rather, in the light of later theory, it may be said that the tubes of electric induction stretching from anode to cathode will more easily find chains of molecules on the point of dissociation through which they will pass, and whose dissociation they will complete. The tubes themselves will break up and discharge their energy in completing the dissociation. In his next paper, "On the Velocity of Propagation of Electric Disturbance," he makes full use of the idea of Grotthus' chains of molecules stretching through the gas, and shows that when such a chain becomes the seat of electric strain, it tends to break up, the atoms re-pairing, and leaving free a positively charged atom at one end and a negatively charged one at the other. He regards the striations as being groups of such chains, each striation being, as it were, a separate electrolytic cell with + atoms turned out at one end and — atoms turned out at the other. The spaces between are regions of combination of the — of one set of chains with the + of the next. We might expect such spaces to be proportional to the mean free path, for, as this increases, so also will the average distance traveled before re-pairing occurs. Observation gives fair confirmation of this. The increase of strength of a layer of gas with diminishing thickness finds an explanation, and he points out that if the distance between the electrodes in a tube is less than the distance between two striæ, then the recombination may not occur sufficiently rapidly, unless the velocity of the atoms is very much increased or extra energy is supplied. In other words, the resistance to the discharge is increased, and this is in accordance with experiment. The dark space at the end of the positive glow is, he supposes, a region where the heat of recombination has produced sufficient dissociation to render the gas easily conducting.

Now came a most important paper describing an experimental determination of the motion and velocity of the glow in an ordinary exhausted tube by the revolving mirror method. The glow was found to start always from the anode, and to move almost to the cathode with a speed nearly that of light. This speed far exceeds anything which could be atributed to the atoms themselves, for with such speed they would require immensely more energy than that supplied by the current. The traveling glow is therefore the propagation of a condition. The electric strain entering the tube passes down the Grotthus chains of molecules from the positive end, and with the speed of light, producing interchanges of patterns along the line.

All these views are set forth much more simply if the electric field and its changes are described by Faraday's induction tubes and their motion; and Thomson now turned to a development of the theory of these tubes, which will be found in his "Recent Researches."

His well-known experiments on the discharge in tubes without electrodes, and on the effect of a magnetic field in such tubes, still further confirmed his view of the nature of the discharge. Some experiments on the electrolysis of steam brought out the remarkable result that an arc discharge turns out the oxygen positively charged, so that it goes to the cathode while the hydrogen is negatively charged and goes to the anode. A spark discharge of a certain length exactly reverses these effects, and turns out the electrolytes at the ends at which they appear in the electrolysis of water. This experiment thus showed that the same atoms could have charges of either sign.

In 1894 the revolving mirror method was applied to measure the velocity of the cathode rays in a Crookes tube. The interval of time between the commencement of phosphorescence on two patches at different distances from the cathode on starting a discharge was measured in a hydrogen tube, and the velocity of the exciting agent was found to be 1.9×10^7 cm./sec., a hundred times greater than the velocity of mean square of hydrogen molecules at 0°C., but only a thousandth part of the velocity of the glow in a less exhausted tube. The velocity of the atoms on Crookes' theory of the rays may be calculated from the known fall of potential at the cathode, and the known charge carried by a known mass of dissociated hydrogen. Equating the electrical energy lost to the kinetic energy gained, Thomson found a velocity almost identical with that given by his experiments.

Combining this with his previous investigation on the magnetic action on electrified particles, it seems impossible to have any further doubt of Crookes' explanation that the so-called rays are a pure stream of electrified atoms. It is a misfortune that we still continue to describe the phenomenon thus, instead of terming it the cathode stream.

Last year further experiments were made to show that gases are electrolysed by the discharge, and the spectroscope was brought into the service. In one experiment a tube was divided in the middle by a metal plate perpendicular to its axis, and the spectra of the gases on the two sides of the plate could readily be compared. The same element was turned out from some compounds with a positive, and from others with a negative charge, and there was evidence tending to show that the spectrum given when the atom is positively electrified is different from that given by the same atom when negatively electrified.

Last December a very important paper was published in the "Philosophical Magazine," in which mechanical illustrations are given of the possibility of an atom being at one time positively and at another time negatively charged. It is shown that in one case it will possess more energy probably than in the other. The ideas derived from the illustrations are used to explain the difficulties in the theory of electrolysis.

I have given the fullest account of Prof. Thomson's researches on the electric discharge in gases, for they appear to me to constitute his greatest work. When he took up the subject there was an immense mass of confused and confusing facts. By his theory of Grotthus chains and their electrolysis, and by the series of test experiments, he has gone far to reduce the mass to order and to establish his theory.

We all know the part Thomson has taken in the work on the Röntgen rays, and have read his account of the subject in the Rede Lecture which he delivered a few weeks ago at Cambridge. Besides his contributions to Science in the form of papers and the works already mentioned, Prof. Thomson has edited "Maxwell's Electricity" and has added a third volume, "Recent Researches in Electricity and Magnetism," worthy of the work which it is intended to supplement. He has recently published a text-book on Electricity, which puts the mathematical theory of Electricity in a form useful to students who are unable to attack the difficulties of Maxwell.

Prof. Thomson's work has been recognized by the Royal Society in the award in 1894 of a Royal medal. He has been elected an honorary member of the Manchester Literary and Philosophical Society and of the Royal Society of Turin.

J. H. P.

MR. CHARLES J. LUTHER, late of the Long Branch, N. J., gas and electric lighting plant, has become superintendent of the Rome, N. Y., Gas Company, succeeding Mr. Parrish, and will operate both its services.

MR. T. F. GROVER, superintendent of the Milwaukee and Wauwatosa Electric Company, has been appointed general manager of the Fond du Lac, Wis., Electric Light and Power Company and will assume his new duties on October 1.

MR. PAUL MINNIS, heretofore General Manager of the Home Telephone Company, of Mobile, Ala., has accepted a position as electrical engineer with the Best Telephone Manufacturing Company, of Baltimore, and the allied Home Telephone Companies of Baltimore, Trenton, Newark, Jersey City, Cleveland and other cities. Mr. Minnis also has charge of the interests of his company for Greater New York with headquarters in this city.

MR. H. LOEWENHERZ, M. E., formerly in the Engineering Department, Metropolitan Telegraph & Telephone Company, of New York, is at present engaged upon extensive inside and outside work now being executed by the New York Telegraph and Telephone Construction Company for the Newark and Hudson Telephone Companies, operating in Newark and Jersey City, respectively.

PROF. HENRI MOISSAN is now making a tour through the Eastern and Middle States previous to proceeding to Princeton to represent the University of Paris at the College celebrations. Before he leaves at the end of the month, he will probably repeat his celebrated experiments with the electric furnace, in New York City, having consented to do so in response to an invitation from various societies. Arrangements are now being made.

MR. PERCIVAL ROBERT MOSES, formerly connected with the Sprague Electric Elevator Company, has now started as a consulting electrical engineer and contractor in the Equitable Building, 120 Broadway, New York, taking as specialties the installation of electric elevators and electric plants in buildings. Mr. Moses is a graduate of the electrical course of the Columbia College School of Mines. Since his graduation he has devoted himself entirely to the subject of electric elevators, and should be competent to deal with the problems they present.

TELEGRAPHERS' STRIKE ON THE CANADIAN PACIFIC.

The telegraphers on the Canadian Pacific Railway, including the train dispatchers, have gone out on strike, certain grievances being alleged. The report that the strike had interrupted traffic on the road is pronounced untrue by Mr. E. V. Skinner, General Eastern Agent of the company. Mr. Skinner said that the trains of the company were running regularly, passenger and freight, and that the places made vacant by the strikers were being filled without trouble.

SOCIETY AND CLUB NOTES.

NATIONAL SOCIETY OF ELECTRO-THERAPEUTISTS.

THE National Society of Electro-Therapeutists which held its annual convention on Sept. 29 and 30 last, proved to be a genuine success. The programme was composed of a large number of interesting and valuable papers, one of the most commendable and desirable features having been the frank admission of many failures in reaching the desired therapeutical result. But the many records of successful treatment by electricity gave this branch of medicine a most hopeful outlook. The president, Dr. A. B. Norton, reviewed in an interesting manner the development of the electro-therapeutist as a specialist, and then called on Dr. F. M. Frazer to read his paper on "The Treatment of Old Paralysis." Dr. Frazer explained how he applied the faradic current to a patient who had lost all control over the motions of his arm. Although the patient was not absolutely cured, the constant application of electricity had the effect of giving the party control over the movements of his arm and hand. In explanation, the author said that the nerve center must have been stimulated sufficiently to respond. The next papers were "A Few Cases Treated by Cataphoresis," by Emily A. Bruce, M. D.; "The Basis of Electro-Therapeutics," by Clara E. Gary, M. D.; "Some Failures and Cures in the Treatment of Endometritus," by F. A. Gardner, M. D., of Washington, D. C.

The evening session was of somewhat more direct interest to the engineer, since a number of engineering problems were brought out. A paper presented by Mr. Ralph W. Pope and Mr. Townsend Wolcott, on Alternating Currents and Transformers, caused a rather lively debate between the reader, Mr. Wolcott, and Lieutenant Jarvis Patten, Dr. Waite and Mr. Osterberg. The latter urged upon the physicians the use of the motor-dynamo in preference to using the current direct from the street, while Dr. Waite went so far as to call the proceeding of applying current directly from the street positively criminal. Lieut. Patten presented an interesting diagram from which he explained how a direct current may be turned into an alternating, and how this same device may be used to serve as a resistance. The principal idea involved in this scheme is to produce a positively uniformly varying alternating current. Dr. F. A. Gardner read a communication on "Some experiments with the Faradic current on a hypnotized subject." He personally experimented on a subject with the assistance of a professional hypnotist, and found most remarkable results. Nerves which under ordinary conditions would violently react were practically inert to the faradic current, when the subject was under the master's influence. The author also mentioned that a slight faradic current is often applied to a person while being hypnotized, but that person must not be aware of any such proceeding.

One of the most carefully prepared papers was that by the former president, Dr. William Harvey King, on the development of the higher vocal register by electricity. He explained how the vocal cord may be made elastic and how its muscular strength may be enlarged by the use of the faradic current.

William R. King, M. D., of Washington; Florence W. Oakey, M. D., of Brooklyn; Irving Townsend, M. D., and others presented papers of more direct interest to the physician than to the electrician. Next year's convention will be held in Washington, D. C., and Dr. F. A. Gardner was elected president for the ensuing year.

HENRY ELECTRICAL SOCIETY.

The first lecture of the season will be delivered at the rooms of the American Institute, Nos. 111-115 West Thirty-eighth street, New York, on Friday, October 9, at 8 p. m., by Mr. G. F. Sever, entitled, "The Development of Electric Railway Practice."

The society has decided to give public lectures every second Friday throughout the season, reserving the intervening Fridays for class work by the members only. This season the class, under the direction of Mr. W. H. Freedman, E. E., will study "Electric Lighting," as outlined in Prof. Crocker's new treatise on the subject which has been adopted as the text book to be followed.

The officers for the following year are: President, G. F. Sever; first vice-president, Nelson W. Perry; second vice-president, L. H. Laudy, Ph. D.; secretary, W. H. Freedman, E. E.

BASE AND SOCKET STANDARDIZATION.

For the greater convenience of several of the manufacturers who have signified a desire to be present, the date of the meeting for discussing the standardization of the incandescent lamp base and socket has been changed from Thursday, October 8, to the following day, when it will be held at 10 a. m. in the rooms of the American Institute of Electrical Engineers, Havemeyer Building, New York.

CHICAGO ELECTRICAL ASSOCIATION.

This association has got up a good programme of work for its coming winter season. The paper for Oct. 2 was on "Modern Views of Electricity," by Mr. F. J. Dommerque; and that on Oct. 16 will be by Mr. Albert Scheible on "Patents as Investments." Papers have been provided for up to Jan. 29.

NEW YORK ELECTRICAL SOCIETY.

The 176th meeting of this Society will be held at Columbia University, Oct. 13, at 8 p. m.

Dr. C. E. Emery will deliver his presidential inaugural address, entitled, "Reminiscences of Forty Years of Engineering Experience."

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION held a well attended meeting at Boston last week, when women physicians were particularly in evidence. Dr. Robert Newman, of New York, presided. Among the topics discussed were the dangers of using street current, a subject to which Mr. J. J. Carty, of New York, addressed himself. The programme has already appeared in these pages. Dr. W. T. Bishop was elected Dr. Newman's successor as president.

LETTERS TO THE EDITOR.

RATED AND ACTUAL HORSE POWER OF ELECTRIC MOTOR AND GAS ENGINE.

In the article on the Morris & Salmon Electric Carriage in The Electrical Engineer for Sept. 30, 1896, there are some statements that are a little misleading.

It is well known that an electric motor can, for a short time, generate about three times its rated horse power. Under the conditions of the Providence race, 8 or 9 horse-power would be a much fairer rating of the power which propelled the Morris & Salom wagon.

It is also suggested that the gasoline motors of 5 brake horse-power could be made to double their power. This seems a little odd. The experience of the writer has tended to the fact, that the rated brake horse-power of a gas or gasoline engine is very nearly its practical working limit, as those familiar with this class of engine know that when overloaded they stop.

Further, the motor carriage builders are working to make their wagons as light as possible, and under the circumstances they would not be likely to carry the extra weight of a 10 horse-power motor to generate only 5 horse-power.

S. A. HASBROUCK, M. E.

New York City, September 30, 1896.

X-RAYS IN A DRY GOODS STORE.

To add to the many attractions of their large establishment, Bloomingdale Bros. have recently opend an X-ray exhibition. A few words as to the details of this apparatus may be of interest. In many respects the apparatus is what may be called standard; but there are a few details that may be new. The coil is an 8-inch Splitdorf with the make and break circuit mounted on the shaft of a motor, the spark at the break being absorbed by condensers. The tube is of the focusing type and is made by Greiner, of this city. These tubes I wish to recommend very highly, as they are, by far, the most satisfactory of any I have ever seen. By proper manipulation I am able to make a very clear photograph of the hand with twenty to thirty seconds exposure, and a picture of the ribs in about ten to fifteen minutes. To operate the tubes to the best advantage, they are enclosed in a box and a gas flame placed inside with the tube; the flame serves for heating the tube as well as keeping the air dry. By this means I have sometimes operated a tube for two hours without shutting it down. A very essential thing in running tubes to their maximum effect is to keep the air around them dry. All who are interested in the X-ray should call at Bloomingdale's and see the apparatus in operation.

H. D. HAWKS.

New York City, Sept. 14, '96.

CLEVELAND, O. The Institute for Home Study of Engineering, Blackstone Building, owned and operated by the Scientific Machinist Company, has just issued a new and interesting catalogue in relation to its well known educational work. We learn that the institute's thorough and practical work in the different branches of electricity, mechanics, mechanical drawing and steam engineering, is proving very attractive to progressive and ambitious mechanical men.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Currents:

ON THE DISTRIBUTION OF HIGH FREQUENCY ALTERNATING CURRENTS THROUGHOUT THE CROSS-SECTION OF A WIRE.—By Ernest Merritt. Author exhibited by plotted curves, the results of extensive calculations from the formulæ of Lord Kelvin and Heaviside.—Note in "Science," Sept. 11, '96.

GRAPHICAL TREATMENT OF ALTERNATING CURRENTS IN BRANCHING CIRCUITS.—By Henry T. Eddy. Author gave an elegant treatment of the general problem of branched circuits containing resistance, inductance and capacity, showing the construction of the locus of the resultant current vector for varying frequency.—Note in "Science," Sept. 11, '96.

Central Stations:

CENTRAL STATION EXTENSIONS.—By G. L. Addenbrooke. Author defends an attack on his previous statement that under ordinary circumstances mains may be extended 2½ miles from the station using a three-wire system and 220 volt lamps.—Lond. "Elec. Rev.," Aug. 28, '96.

Dynamos and Motors:

COMBINED ALTERNATING AND CONTINUOUS DYNAMO AT WOOLWICH.—By F. J. Moffet, B. A. The object which the designers of this machine had in view, was to obtain in the case of an alternating current dynamo the same elasticity of output, which is possessed by a direct current machine when running in parallel with a set of storage cells.—Description of machine and diagram of connections of compound switch in Lond. "Elec.," Aug. 28, '96.

ARMATURE WINDINGS AND CONNECTIONS.—By Cecil P. Poole. Previously referred to; see for reprint "Scient. Mach.," Sept., '96.

NON-SYNCHRONOUS TWO-PHASE ALTERNATING CURRENT MOTOR.—See Syn., Sept. 23; also 'Elec. World," Sept. 12, '96.

Educational;

THE ARTISTIC ELEMENT IN ENGINEERING.—By Frank O. Marvin. Paper read before the Section D of the Buffalo meeting of the Am. Assoc. for the Advancement of Science. Author treats American engineering right through its gradual development and shows the development of æsthetics.—"Science," Sept. 11, '96.

THE WORK OF THE REICHSANSTALT.—A report of the work accomplished during the past year.—Lond. "Elec.," Aug. 28, '96.

Electro-Chemistry:

ELECTROLYSIS AND SOME OUTSTANDING PROBLEMS IN MOLECULAR DYNAMICS.—By Carl Leo Mees. Read before the Am. Assoc. for the Advancement of Science.

A THEORY OF GALVANIC POLARIZATION.—By W. S. Franklin and L. B. Spinney. Existence of a term in the energy equation of the electrolytic cell is pointed out, depending upon an irreversible or sweeping process at each electrode. Experiments were described showing that the coefficients of these terms do not in general vanish with the current.—"Science," Sept. 11, '96.

ON IRREVERSIBLE CELLS.—By A. E. Taylor. This paper is practically a continuation of the work of Bancroft on single liquid polarizable cells, with special reference to the effect of the negative ion on the potential difference between an electrode and the electrolyte in which it is immersed.—"Journ. of Physical Chemistry," Oct., '96.

Electro-Physics:

MECHANICAL MODELS OF THE CIRCUIT.—By Brown Ayres. A model was constructed showing nearly all the fundamental phenomena of the electric circuit, particularly those of oscillation and resonance.—Note from "Science," Sept. 11, '96.

VISIBLE ELECTRIC WAVES.—By B. E. Moore. Author describes an arrangement in which stationary electric waves on a wire are rendered visible by the brush discharge from the various points of the wire.—Note in "Science," Sept. 11, '96.

ELECTRIC WAVES IN LONG PARALLEL WIRES.—By A. D. Cole. Author has carried out some work in connection with the determination of the dielectric constants of liquids.—Note in "Science," Sept. 11, '96.

INFLUENCE OF THE STATIC CHARGE OF ELECTRICITY ON THE SURFACE TENSION OF WATER.—By E. L. Nichols and John Anson Clark. Authors used a dropping apparatus for determining the surface tension, and a novel electrometer for measuring e. m. f. The electrometer consisted of a light conducting sphere suspended by a long conducting fiber near a large plane plate.—Note in "Science," Sept. 11, '96.

Lighting:

ON THE COUNTER E. M. F. OF THE ELECTRIC ARC. —By W. S. Franklin. Author attempted the experimental determination of the decay of the e. m. f. between the carbons of the electric arc after the circuit is broken.—Note in "Science," Sept. 11, '96.

Measurements:

A NEW ALTERNATING CURRENT CURVE TRACER.—By Edward B. Rosa. An apparatus by means of which the successive points in an alternate current or e. m. f. curve are plotted directly, avoiding the necessity of taking and entering numerical observations.—Note in "Science," Sept. 11, '96.

Mechanical:

WESTINGHOUSE GAS ENGINE.—A brief description of the new gas engines adapted for dynamo driving.—"R'way Review," Sept. 26, '96.

Power Transmission:

NEVADA COUNTY (CAL.) ELECTRIC POWER COMPANY.—A Head of 206 feet is attained on the River, and the water is carried to Pelton Wheels through 300 feet of 48 inch, 44 inch and 42 inch pipes, giving in all 2,500 h. p. Two 340 k. w. two-phase 5,000 volt generators running at 400 revolutions are installed; also two 5 k. w. exciters.—For detailed description see "Elec. Eng'r." Sept, 16, '96.

Railways:

COMBINED CONDUIT AND OVERHEAD SYSTEM.—This trolley tramway system has been developed in Washington. Besides a brief description, the illustrations help to explain the system.—"R'way World," Sept., '96.

WORKING EXPENSES OF ELECTRIC AND CABLE RAILWAYS.—Only one cable road is mentioned and that is compared with the Liverpool Electric and London electric systems.—"R'way World," Sept., '96.

Roentgen Rays:

NOTE ON THE DURATION OF THE X-RAY DISCHARGE IN CROOKES TUBES.—By Benjamin F. Thomas. Slow make and break in the primary of an induction coil produces almost as strong effect on a Crookes tube as very rapid make and break. This seems to indicate the long duration of activity of the tube at each discharge. Author has shown that the duration of the acting discharge is as short as 1/5000 and probably as short as 1/50000 second.—Note from "Science," Sept. 11, '96.

ROENTGEN RAYS IN OPHTHALMIC SURGERY.—Dr. Lewkowitsch has devised a method for detecting foreign bodies in the eye.—From Lond. "Lancet," in "Elec. Rev.," Sept. 2, '96.

Telegraphy:

ENGLISH POSTAL TELEGRAPH SERVICE.—From the annual report of the Postmaster General, the following table is abstracted:

Class of Telegrams.	Number. Year, '95-'96.	Receipts.
Ordinary Inland	64,563,587	£2,046,456
Press Inland	5,915,646	124,881
Foreign	6,701,838	331,717
Railway, free	1,338,818	......
Railway, half rate	24,350	469
Government, free	295,371	......

—Lond. "Elec.," Aug. 28, '96.

ARRANGEMENT FOR COUNTING CONVERSATIONS OF TELEPHONE SUBSCRIBERS.—By Jul. H. West.—From "Elektrotechn. Zeitschr." in "Elec. World," Sept. 12, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPT. 29, 1896.

Alarms and Signals:—

SIGNAL BOX. C. W. Cornell, East Orange, N. J., 568,335. Filed Dec. 5, 1895.
Means for permitting the operation from a distance of a normally unwound signal box.

ELECTRIC ALARM FOR STEAM GAUGES. A. Ransom and A. J. Corrothers, Wise, W. Va., 568,370. Filed Jan. 25, 1896.
Details of construction.

SIGNALING BY MEANS OF LIGHTS. L. Sellner, Vienna, Austria-Hungary, 568,374. Filed Nov. 19, 1895.
Comprises a signaling element composed of two normally obscured signal lights of unlike color, and adapted to alternately expose the lights to view.

ANNUNCIATOR. C. E. Beach, Binghamton, N. Y., 568,423. Filed Aug. 16, 1895.
Comprises a magnet, an armature mounted on a revoluble part to rotate therewith and having an independent vibratory motion in the direction of the magnet, together with a ledge for holding the armature.

ANNUNCIATOR TIME CALLER FOR RAILROAD TRAINS. J. J. Cowhig, Manassas, Va., 568,430. Filed Feb. 25, 1896.
Consists of a board having a clock face and hands, lettered sliding paddles, a drop board and an alarm bell, the latter two operated by electricity and a switch.

ELECTRIC WEATHER INDICATOR. W. M. Kelch, Dayton, O., 568,444. Filed Nov. 21, 1894.
Comprises mechanism for simultaneously indicating at different localities, from a single point, information appertaining to the weather.

AUTOMATICALLY TESTING FIRE ALARM CIRCUITS. L. G. Rowand, Camden, N. J., 568,493. Filed Aug. 2, 1895.
Employs a local battery, the various circuits, etc., being automatically by clock mechanism switched into circuit with the local battery.

ELECTRIC FIRE ALARM CIRCUIT AND SIGNAL BOX. L. G. Rowand, Camden, N. J., 568,494. Filed Aug. 8, 1895.
Details of construction.

FIRE ALARM CIRCUIT. L. G. Rowand, Camden, N. J., 568,495. Filed Aug. 13, 1895.
Details of construction.

ELECTRIC SIGNALING APPARATUS. A. Garing, Carlstadt, N. J., 568,606. Filed April 21, 1896.
Adapted for use on trolley roads.

ELECTRIC BELL. F. Davey, Detroit, Mich., 568,668. Filed Feb. 17, 1896.
A single stroke bell.

Batteries, Secondary:—

SECONDARY BATTERY. F. King, London, England, 568,447. Filed April 10, 1896.
Means to effect circulation of the electrolyte over the surfaces of the plates.

Dynamos and Motors:—

ALTERNATING CURRENT ELECTRIC MOTOR. F. S. Hunting, Fort Wayne, Ind., 568,350. Filed Aug. 31, 1892.
Comprises a closed secondary circuit and means for varying the phases of the electromotive forces developed in its different parts.

BRUSH HOLDER. S. H. Short, Cleveland, O., 568,413. Filed Oct. 29, 1895.
Comprises an adjustably mounted brush-supporting board of suitable non-conducting material arranged between the brush and the end of he motor armature.

ARMATURE WINDING. S. H. Short, Cleveland, O., 568,414. Filed April 20, 1896.
An armature coil having side and end portions, the side portions provided with paper insulation, and the end portions provided with tape insulation.

FLAT WINDING FOR ARMATURES. S. H. Short, Cleveland, O., 568,415. Filed May 4, 1896.
Details of winding.

CONSTANT POTENTIAL ALTERNATING GENERATOR. C. P. Steinmetz, Schenectady, N. Y., 568,464. Filed April 30, 1894.
The combination of an alternator, an exciter, a regulating machine in the exciter circuit, and a field coil on the regulating machine energized by the rectified current of the alternator.

CONSTRUCTION AND OPERATION OF CIRCUITS FOR ELECTRIC MOTORS. F. E. Herdman, Winnetka, Ill., 568,566. Filed June 21, 1895.
Adapted for use with electric motors operating elevators.

ALARM DEVICE FOR ELECTRIC MOTORS. W. A. Gibbs, Pawtucket, R. I., 568,608. Filed Dec. 14, 1895.
Indicates when the armature touches a pole piece of stationary magnet of the motor.

Electro-Metallurgy:—

PROCESS OF PICKLING METALS. A. S. Ramage, Chicago, Ill., 568,412. Filed April 9, 1894.
Consists in a neutral solution of the salt of the metal to be pickled, such solution being acidified, and passing a current of electricity from the article to be pickled through the solution.

Lamps and Appurtenances:—

MEANS FOR ATTACHING OR DETACHING ELECTRIC LIGHT GLOBES. F. W. Mayer, Hartford, Conn., 568,408. Filed June 26, 1896.
Comprises a pair of bands adapted frictionally to engage a lamp-globe at different points in its length.

BRACKET FOR ATTACHING INCANDESCENT LIGHTS TO COMPOUND GAS FIXTURES. E. C. Howe, Bridgeport, Conn., 568,573. Filed July 20, 1896.
Comprises an adjustable bracket which will permit the light to be swung into any desired position.

ELECTRIC ARC LAMP. W. Jandus, Cleveland, O., 568,721. Filed March 5, 1896.
Inclosed carbon type.

Miscellaneous:—

MANUFACTURE OF GRAPHITE. E. G. Acheson, Monongahela City, Pa., 568,323. Filed Dec. 27, 1895.
Consists in subjecting a carbid to the action of an electric current and thereby decomposing it and causing the combined carbon to separate in the form of graphite.

ELECTRIC THERMOSTAT. J. E. Meek, New York, 568,451. Filed May 20, 1896.
Adapted for use in electric heaters.

EXTINGUISHING ELECTRIC ARCS. W. B. Potter, Schenectady, N. Y., 568,450. Filed June 20, 1896.
Consists in causing the lines of force of an arc rupturing means to localize the arc at approximately a given point of the contacts, and then to rupture it.

SYNCHRONIZING DEVICE FOR ELECTRIC CLOCKS. W. J. Cruyt, Brussels, Belgium, 568,475. Filed Jan. 7, 1895.
Details of construction.

ELEVATOR MECHANISM. H. R. Wellman, North Tonawanda, N. Y., 568,506. Filed Jan. 13, 1896.
Means for converting the rotation of a driving shaft into a rectilinear motion of a cross-head and to provide a means for operating this shaft by means of two motors.

ELECTRIC ELEVATOR. F. E. Herdman, Winnetka, Ill., 568,567. Filed Oct. 5, 1895.
Means to enable the elevator to be driven from the motor shaft without form or gear.

ELEVATOR MOTOR CONTROLLING DEVICE. F. E. Herdman, Winnetka, Ill., 568,568. Filed Oct. 5, 1895.
Means whereby the strength of the field in the motor at predetermined points in the travel of the elevator is automatically increased.

BRAKE MECHANISM FOR ELECTRIC ELEVATORS. F. E. Herdman, Winnetka, Ill., 568,569. Filed Oct. 5, 1895.
Means so that the brake shall not be removed until sufficient power is on the machine to enable it to move the load in the direction required.

BRAKE MECHANISM FOR ELECTRIC ELEVATORS. F. E. Herdman, Winnetka, Ill., 568,570. Filed Oct. 5, 1895.
Means to make the application of the brake vary as the conditions of speed and load vary.

BRAKE MECHANISM FOR ELECTRIC ELEVATORS. F. E. Herdman, Winnetka, Ill., 568,571. Filed Oct. 5, 1895.
Similar to above.

INSULATING COMPOUND. L. Honig, St. Louis, Mo., 568,683. Filed June 24, 1896.
Consists of alcohol, shellac, powdered asbestos, glycerin, glue and wheat flour.

ROENTGEN RAY EXHIBITION APPARATUS. A. A. Hamerschlag, New York, 568,720. Filed May 20, 1896.
The combination of a casing, one or more fluorescent tubes therein, heads adjustably supported upon the casing, and one or more fluoroscopes or eyepieces hinged to said heads.

Railways and Appliances:—

RAIL BOND. F. H. Underwood, Auburndale, and F. H. Daniels, Worcester, Mass., 568,385. Filed April 7, 1896.
Embodies a terminal made separate from the conductor and provided with a hole for the conductor and a hole for a drift pin.

TROLLEY WIRE SUPPORT. W. A. McCallum, Cincinnati, O., 568,452. Filed March 2, 1896.
The action of the wire itself retains it immovably in position.

TROLLEY SYSTEM FOR ELECTRIC RAILWAYS. C. E. Davis, Chicago, Ill., 568,523. Filed April 27, 1896.
Designed for use in mines.

SIGNALING SYSTEM FOR RAILWAYS. F. C. Timpson and R. F. Rankin, Philadelphia, Pa., 568,644. Filed Dec. 14, 1895.
Comprises a line circuit, a magneto-machine having a tubular shaft, an electromagnetic signaling device and a rod mounted in the shaft and adapted to extend into range of a key and to reset the signaling device.

ELECTRIC TRACK CIRCUIT RAIL JOINT. G. H. Williams, Fort Smith, Kan., 568,650. Filed March 18, 1896.
A fish plate or angle bar having a longitudinal conductor receiving groove extending from end to end along its upper edge.

ELECTROMAGNETIC ADHESIVE DEVICE. A. A. Honey, Tacoma, Wash., 568,682. Filed Jan. 25, 1896.
Means for increasing the tractile power between wheels and rails.

RAIL BOND FOR ELECTRIC RAILWAYS. C. C. Benson, Covington, Ky., 568,713. Filed Dec. 1, 1894.
Consists in a bond having a connecting wire and split collar, the latter adapted to be driven into the aperture of the web.

Regulation:—

TANDEM PARALLEL CONTROLLER FOR INDUCTION MOTORS. W. B. Potter and F. E. Case, Schenectady, N. Y., 568,458. Filed Aug. 31, 1895.
Comprises contacts and cross-connections adapted to connect the motors in tandem or parallel at will, and cut-out switches arranged to cut out part of the motors without affecting the operation of the remainder.

Switches, Cut-Outs, Etc:—

ELECTRIC SWITCH. J. E. Meek, New York, 568,450. Filed March 20, 1896.
Embodies a swinging knife blade to which the supply current is delivered, and a rotating table having its axis non-coincident with the pivotal point of the swinging knife blade.

Telegraphs:—

PERFORATOR. C. L. Buckingham, New York; E. Germann and J. W. A. Gardam, Brooklyn, N. Y., 568,512. Filed Aug. 13, 1895.
Designed to perforate material for use in telegraph transmitters.

TELEGRAPH RECEIVER. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 568,513. Filed May 11, 1896.
Comprises step-by-step feed, a manual controller, a catch and means operatively connected therewith for actuating the catch by the power applied to move the controller.

PERFORATOR AND CIRCUIT CONTROLLING APPARATUS THEREFOR. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 568,514. Filed May 11, 1896.
The combination with a series of controlling keys, of a system of yielding chains transverse thereto and punch controlling devices connected to the chains.

PERFORATING MACHINE. C. L. Buckingham, New York, and E. Germann, Brooklyn, N. Y., 568,515. Filed May 11, 1896.
Comprises a punch wheel having radially projecting punches, and a series of co-operating dies formed as a flexible band.

PERFORATOR. C. L. Buckingham, New York; J. Gardam and E. Germann, Brooklyn, N. Y., 568,516. Filed May 11, 1896.
Comprises a series of punch actuating magnets, a series of circuit selecting keys for operating the punches, a paper feed, and a series

of feed controlling magnets different ones of which are brought into action by the keys according to the extent of feed required.

TELEGRAPH SOUNDER. D. M. Dunn, Abingdon, Va., 568,527. Filed Jan. 27, 1896.

A combined relay and sounder, comprising a relay-magnet having attached to its armature a buckled plate held fixedly at one end and adapted to have its plane shifted with a click by the movement of the relay armature.

TELEGRAPHY. R. Greville-Williams, Heywood, England, 568,675. Filed Oct. 5, 1895.

Apparatus for the fac-simile reproduction at a distance of designs, drawings, manuscript, etc.

Telephones:—

TELEPHONE MECHANISM. J. L. Given, Stony Point, N. Y., 568,346. Filed Dec. 6, 1894.

Means for separately registering the use of a telephone by more than one subscriber.

SUBSTANCE FOR TELEPHONE ELECTRODES. D. Drawbaugh, Eberly's Mill, Pa., 568,526. Filed Jan. 10, 1896.

Comprises platinum-black in an agglomerate mass divided into granules.

AUTOMATIC SWITCH ARM FOR TELEPHONE RECEIVERS. H. Marcuse, Berlin, Germany, 568,577. Filed Jan. 7, 1896.

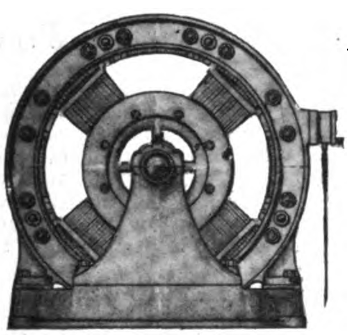
Means to avoid manipulating the receiver by hand.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

C & C INDUCTOR ALTERNATOR.

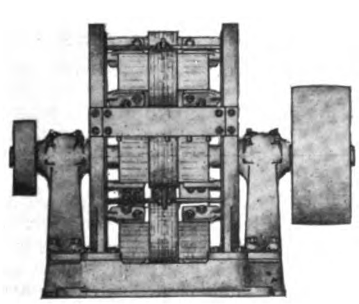
THE C & C Electric Company, so long and favorably known as manufacturers of continuous current dynamos and motors, are about to launch into a new field; and if prospects count for anything, the C & C inductor alternator will soon be as well established on the market as is now the case with C & C motors. The tendency of the age is to simplify electrical machinery, and as far as possible avoid the necessity for



NEW C & C ALTERNATING CURRENT GENERATOR.

using commutator or collector. In the new C & C alternators (inductor type) simplification seems to be a predominating feature, while at the same time no pains have been spared to make these alternators, not only of high efficiency, but of great durability.

Among the details most perfectly worked out in the machine is pre-eminently the fact that all windings may be removed and replaced, even by a novice, in a very short period of time.



NEW C & C ALTERNATING CURRENT GENERATOR.

The magnetic circuit is most carefully constructed of laminæ of soft charcoal iron, and all tendencies to iron losses are most carefully guarded against.

The rotor, or rotating part, is a simple piece of steel in which the magnetic flux has a constant value, excepting for the projecting lugs, which are built of laminæ of soft charcoal iron, in which there is but small change of the magnetic flux.

The machines illustrated in the accompanying engravings are wound for any voltage, namely, 125, 250, 500, 1,000, 2,000, 5,000, 10,000, and the insulation is such that at any of these voltages a perfect performance is realized. The speeds are low in all cases, being but 900 revolutions per minute in the smallest size. The frequency is established at sixty periods per second as a standard, but machines of any frequency will be furnished on demand.

The C & C Electric Company propose to construct regular sizes as follows:

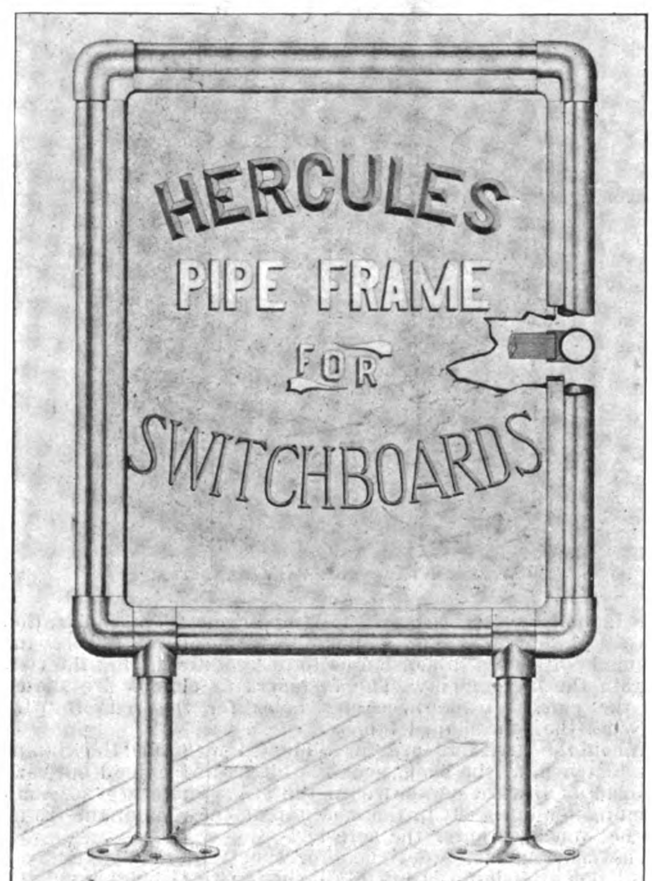
K. W.	Speed.
25	900
50	720
100	600
200	450
400	360

Transformers will be furnished in all regular sizes, and the switchboard equipment will be most perfect and complete.

The C & C Company anticipate a good demand for their new equipment, and, we are informed by Mr. T. J. Fay, general manager of the company, that already there are many prospective sales in sight, notwithstanding the fact the political situation makes business in general hard to get.

A PIPE SWITCHBOARD FRAME.

THE accompanying sketch illustrates an unique style of tubular frame for mounting switchboards. As the cross section shows, its parts are, the tubular frame, screwed into fittings to make corners or to secure outlets for stanchions, braces, etc., and special channel pieces which receive the marble, or slate board proper, holding same rigidly in its place.



PIPE FRAME FOR SWITCHBOARDS.

The advantages derived from this frame are evident. It protects the edge of the board from damage by ill use, and it mounts it in a fashion which permits of unlimited disposal of the slab. The back of the board is perfectly clear, as there are no angle irons or braces in the way of running wiring, bus bars, etc., and the dangers of accidental contact between live metal connections and parts of switchboard mountings, is, of course, removed. A sample of this board created such interest at the late Electrical Exhibition in New York, that its original designers—the John Simmons Company, of 110 Centre street, New York City—have decided to push it, being justified in

believing in its merits from the favorable comments of electrical experts. The Hercules frame is being placed on the market in iron and brass, with a variety of finishes, and the John Simmons Company have erected in their own extensive plant a switchboard mounted on Hercules frame, where it may be seen in actual and severe use.

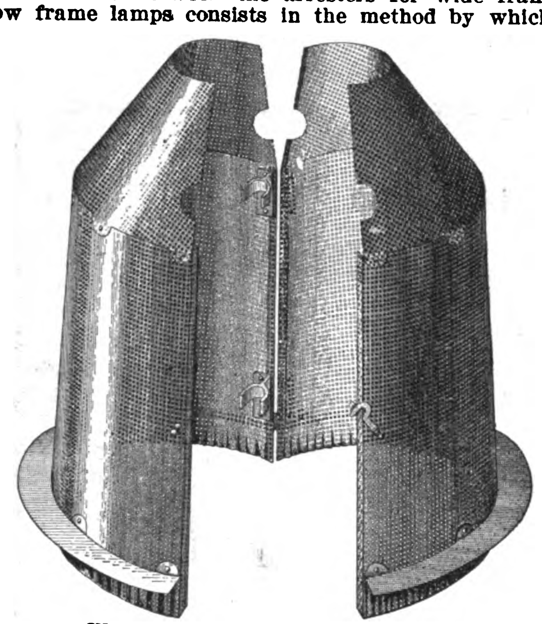
THE WESTERN ELECTRIC SPARK ARRESTER.

THESE arresters are manufactured of perforated sheet steel, neatly japanned. The body, or main part of the device has securely fastened to it a rim of sheet iron a short distance from the lower edge; this rim rests upon the top of the lamp globe. The cone-shaped top is substantially riveted to the body of the arrester, not only making it rigid, but also increasing its usefulness as a safeguard against the wandering sparks. This additional cone is a feature commended by the underwriters. The arrester has been fully tested by them and meets with their approval.

The arrester is made in two parts, fastened by hinges at the back, which allows it to be opened or closed easily when placing it on or removing it from the lamp. It is made in three different styles: for wide frame arc lamps, and for the Western Electric constant potential arc lamps.

For both the narrow and wide frame arc lamps, the total height is ten inches; the distance from the top of the arrester to the iron rim is nine inches, one inch of the arrester extending within the lamp globe. The diameter of the base is 7½ inches.

The difference between the arresters for wide frame and narrow frame lamps consists in the method by which they



WESTERN ELECTRIC SPARK ARRESTER.

are fastened to the rods of the lamp frame. The illustration shows the arrester for a narrow frame lamp, where the frame is of such a dimension as to necessitate having the rods within the lamp globe. The fasteners or clamps are shown in the cut, also the necessary holes for the rods to pass through the cone-shaped top.

When the arresters are for wide frame lamps the clamps are fastened, at the back, near the hinge, and extend outward instead of inward as shown in the cut. There are no small openings or holes cut in the cone top as the rods of the frame do not touch or enter the arrester.

The spark arrester designed for the Western Electric constant potential lamp is but 8½ inches in total height and the iron rim is ½ inch from the bottom. The clamps are inside, as shown in the illustration. The diameter of the base is 7½ inches.

These arresters are not only a safeguard against fire, but are an additional protection against insects and bugs which so frequently obstruct the arc light globes. They are unaffected by heat, and are no obstruction to the illuminating power of the lamp. They are manufactured by the Western Electric Company of Chicago and New York.

THE BOOK, by Messrs. E. P. Thompson and W. A. Anthony, on "Röntgen Rays and Phenomena of the Anode and Cathode," is selling well and rapidly, the rate reaching, it is said, a hundred per day. It is a very useful volume to the student and investigator.

ADVERTISERS' HINTS.

THE STANDARD PAINT COMPANY have recently established an office at 189 Fifth avenue, Chicago.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY publish a testimonial letter from a user of their "type C" governor.

THE ELECTRIC APPLIANCE COMPANY are advertising "Armorite" conduit as being waterproof, fireproof and electrically and mechanically perfect.

J. ERLANDSEN, 172 Centre street, New York, has a well equipped shop for model and experimental work, and the manufacture of light machinery and tools.

THE C & C ELECTRIC COMPANY state that during the first six months of this year they installed 499 horse-power in motors in New York, more than any other company.

MESSRS. H. B. COHO & COMPANY, of this city, have just completed a model isolated plant for Jas. McCreery & Company, the well known dry goods house.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., have arranged a variety of courses of home study differing in price from $14 to $120.

MR. E. V. BAILLARD, is now dealing in apparatus for the production of Röntgen rays. Full details as to prices, etc., may be obtained by addressing him at 106 Liberty street, New York.

STUCKY & HECK, ELECTRICAL MANUFACTURING COMPANY, LTD., of 35 N. J. R. R. avenue, Newark, N. J., do every variety of repair work, making a specialty of railway business.

EDWARD P. SHARP, Buffalo, N. Y., is offering some very excellent bargains in wire, switches, circuit breakers, fare registers and other electrical goods; a list of which will be sent on request.

THE GENERAL ELECTRIC COMPANY'S transformers are the result of years of experience and effort to make them perfect. Prospective purchasers are invited to make their own tests before acceptance.

THE WALKER COMPANY direct attention to the construction of their railway motors in which the bearings are placed outside of the motor, thus eliminating all possibility of the grease permeating the armature and field coils.

THE BERLIN IRON BRIDGE COMPANY illustrate in their "ad" a highway bridge constructed of wrought iron, at Jewett City, Conn. This company are constantly adding to the already long list of central stations built by them to be absolutely fireproof.

THE STANDARD ELECTRIC LAMP AND NOVELTY COMPANY have secured the services of Mr. Charles F. Reinmann as electrician, under whose direction they will continue to manufacture their lamps for decorative and surgical purposes and the many other specialties which this company carries.

STEVENSON & SON, of London, make a request in our advertising columns this week for American agencies. Mr. E. A. Stevenson, the head of the firm, is well known in this country, having been electrician to the Telegraph Construction and Maintenance Company for thirty years, during which period he has traveled all over the world and made an extended acquaintance in many countries. The firm will be glad to push abroad anything new or meritorious.

NEW YORK NOTES.

MR. ALBERT C. JAHL, manufacturers' agent, at 39 Cortlandt street, New York, is giving away to his friends at present, a useful little pocket match folder, on which is a reminder that he handles electrical supplies. Mr. Jahl has a number of specialties and will be glad to communicate with all purchasers of electrical goods.

THE HART & HEGEMAN MFG. CO., of Hartford, Conn., have appointed Mr. William Taylor, formerly of the Electrical Supply Company, of Chicago, as their representative in New York City. Mr. Taylor has secured offices in the Mail and Express Building, 203 Broadway, and will carry a full line of the well known Hart & Hegeman snap switches.

CHAS. J. BOGUE, of 206 Centre street, New York City, has issued a catalogue and price list of "American" dynamos and lamp parts. It includes a list, with prices of all the parts, and sheets of engravings with numerals to correspond. Mr. Bogue is also in the market for all the electric lighting repair work in sight. He makes a specialty of armature rewinding.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. OCTOBER 14, 1896. No. 441.

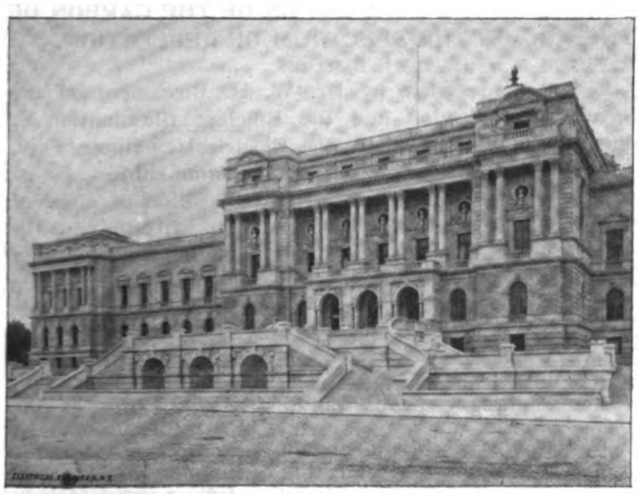
ELECTRIC LIGHTING.

THE NEW CONGRESSIONAL LIBRARY BUILDING, WASHINGTON, AND ITS LIGHTING PLANT.

BY N. MONROE HOPKINS.

CHIEF among the new attractions of the National Capital, and a place destined to rank as one of the most important Federal institutions, is the new Congressional Library, upon which time, money and talent have been unsparingly lavished. All who know the old library in the Capitol are aware of its terribly crowded condition and of the imperative necessity that has long existed for new quarters worthy of the work and adequate to the needs of that which is the official literary centre of the United States. From the fact that the library has been of great use to Senators and members of Congress, few legislators have been willing that it should be removed, but the present arrangement, which establishes the library in a magnificent new building close to the Capitol, with means of swift delivery and intercommunication, is likely to answer admirably. There is, however, additional safety in having the priceless collection of book, copyright material, documents, etc., placed by themselves, under modern methods, and in a building which embodies every possible element and feature of preservation from fire and decay.

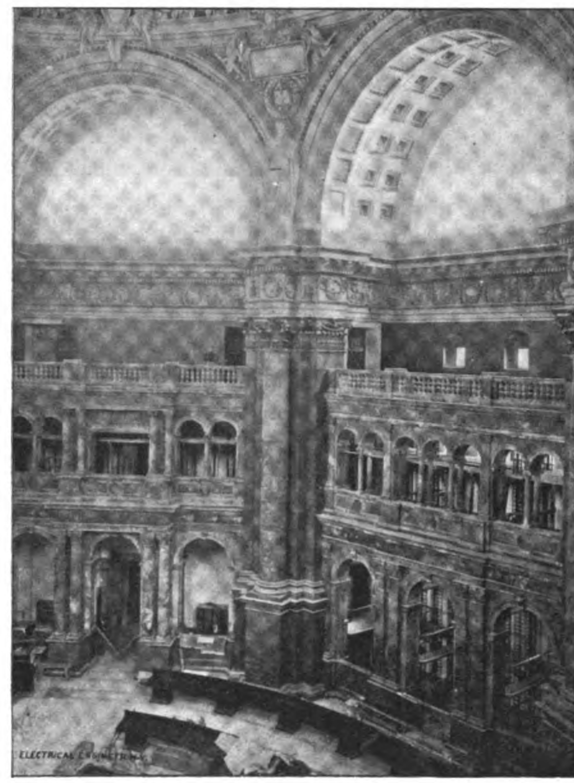
The new building for the Congressional Library at Washington was erected under the direction of the late Gen. Thomas Lincoln Casey, Chief of Engineers of the Army, who was instructed by an act of Congress of March 2, 1889, to carry out the plans for a building to cost $6,000,000, made under his supervision. The plans were evolved from those made previously by Messrs. Smithmeyer & Pelz, architects. In December, 1892, Gen. Casey placed his son, Edward Pearce Casey, then a recent graduate of the architectural department of the Ecole des Beaux-Arts, at Paris, in charge of the interior finish and decoration of the building. With an efficient staff,



THE NEW CONGRESSIONAL LIBRARY, WASHINGTON, D. C.

headed by Elmer E. Garnsey for mural painting, and Albert Weinert for sculptural decoration, this work has been steadily carried forward, and is now approaching completion, so that it is expected that the library will be ready for occupancy in February or March of the coming year.

It is impossible without far transgressing the limits of an article intended to call attention to only one important part of the engineering work to go into any account of the superb decoration that has been placed on the walls, or of the special paintings, statuary, marbles, mosaics, etc., but note cannot be avoided of one or two. American artists have never had such an opportunity before, especially for mural painting, and



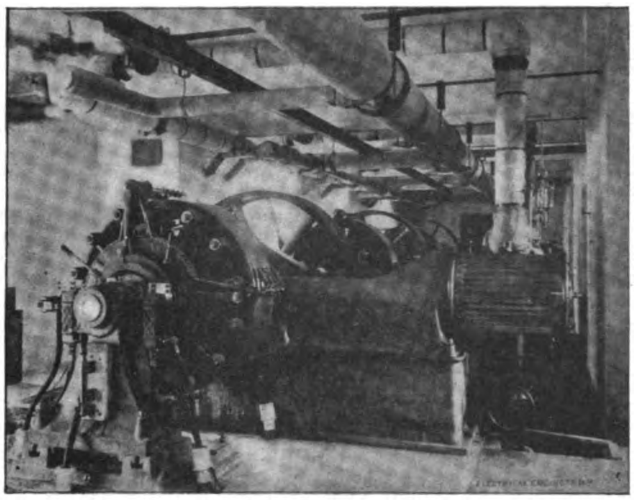
CENTRAL HALL, NEW CONGRESSIONAL LIBRARY.

the results will make a profound impression on all who see them. Moreover, the fact must be emphasized that the use of electric light renders possible the freest resort to such ornamentation and is the surest preventive of their spoiling under the action of deposits from gas, while at the same time, better illumination can be effected generally. All the paintings have been studied from the standpoint of their environment, and such work as that of Mr. E. H. Blashfield in the dome of the great rotunda or reading room is also a remarkable example of fine decorative effect, with an eye to the lighting. The collar of the dome here is no less than 150 feet in circumference, surrounding the eye of the lantern at a height of 125 feet from the ground, whence it has to be seen, unless the visitor ascends to the gallery, 30 feet higher, as shown in one of the illustrations. The details of the lighting are, of course, largely to be judged later, when the library is in use, and when all the paintings, color schemes, etc., can be seen at their best. As to the statuary, this is not less striking and fitting. Within the rotunda just mentioned are a large number of figures, among which are one of Joseph Henry, by Herbert Adams; Fulton, by E. C. Potter; Science, by John Donoghue. On the front of the building are a series of busts in niches, among them being one of Franklin, by F. W. Ruckstuhl.

The lighting plant for the new Congressional Library at Washington, which has recently been put in place, is illustrated by our annexed engravings. Bids were called for on apparatus and material, and in many instances the work of installation was carried out by government employes. An air

of thorough and substantial work prevails from the basement and cellars to the golden torch which surmounts the golden dome above the reading room.

The steam plant for lighting and heating is situated under the east parking, and the electric plant is 140 feet distant in

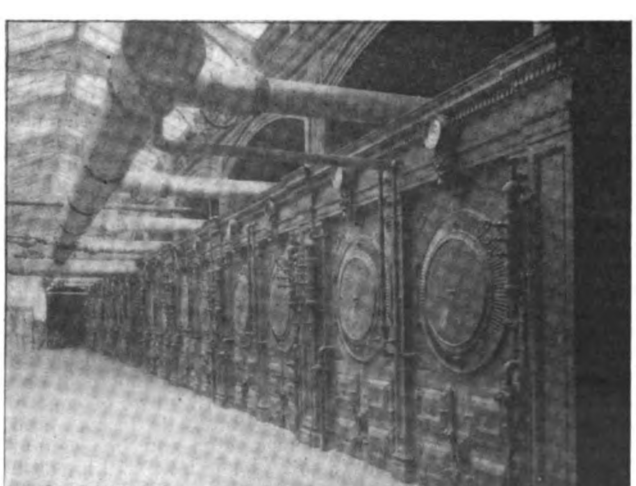


Direct Connected Dynamo Plant, New Congressional Library.

the basement. The battery of boilers is claimed to be one of the handsomest in the United States, although comparatively small. The battery consists of sixteen 60 horse-power horizontal tubular boilers, supplying steam at 90 pounds initial pressure. The boiler room is 140 feet long and 41 feet wide, with a clearance in front of the battery of 16 feet. The boilers and steam gauges were supplied by Thomas C. Basshor & Co., of Baltimore, Md., and are so arranged that any one may be thrown in or out of use, whether for lighting, heating or pumping. The feed water is supplied by a No. 7 steam pump, furnished by M. T. Davidson, of Brooklyn, N. Y. Two Davidson No. 13 pumps are also installed for the water supply of the building and the elevators. All the piping was done by government employes. The piping, valves, etc., were furnished by Bartlett, Haywood & Co., the Crane Co., and the Reading Iron Co. The stoking is to be done by hand.

The boiler room is entirely covered by a glass skylight, running from end to end. Ten-inch asbestos covered pipes supply steam to the engines, and 12-inch pipes are used for the exhaust.

The engine plant consists of four Ball engines of the straight-line, single-cylinder, non-condensing type. Three of these have 16-inch cylinders and 16-inch stroke and are di-

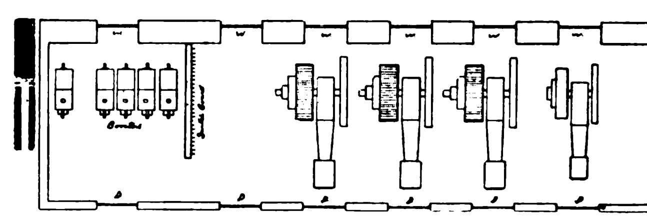


Boiler Room, New Congressional Library.

rectly connected to three four-pole Siemens & Halske generators of 100 kilowatts capacity, each with a speed of 130 revolutions, delivering the current at 130 volts. The fourth engine, somewhat smaller, is directly keyed to a General Electric six-pole machine, with a capacity of 196 amperes, at 125 volts when revolving at the rate of 300 turns per minute. Five boosters are used, which were supplied by the Northern Electrical Manufacturing Co., of Madison, Wis. These are designed for a speed of 1,..0 and a voltage of 7½. They are located, as shown in the diagram, behind the switchboard. The switchboard is of white marble, and measures 8 feet by 20, and consists of 6 panels. The indicating instruments are of Weston manufacture, and are twenty-two in number. The automatic cutouts are equipped with carbon-breaking contacts and were supplied by the Cutter Electrical and Manufacturing Co., of Philadelphia. The switches were supplied by the W. S. Hill Co., of Boston. The lower row of switches is used to throw in the boosters. The flooring is cement, with iron plate around the machinery. The wires and cables are of the "Simplex" make, and are carried throughout in the iron armor insulated piping of the Interior Conduit Co. Fourteen 30-inch Davidson fans, operated by Lundell motors, are placed in efficient localities. The wiring is on the two-wire system, and is designed for 8,000 lights. The plant, already in place, is designed for 6,000 lights.

As to the methods of illumination, it may be stated in general that the entrance to the library will be lit up by fourteen clusters of incandescent lamps, mounted on ornamental standards. In fact, there will be no arc lights used. The rotunda will be lighted from the cornices and will take no fewer than 2,800 lamps of 32 candle-power. Cornice lighting will play a prominent part throughout the building, but in some of the smaller reading rooms chandeliers and side brackets will be resorted to. In the main reading room, under the rotunda, the desks are arranged in circles and carry 12 candle-power lamps on short standards, with shades. The lighting of the halls will be by 16 candle-power lamps wired into the cornices. The effects thus obtained everywhere are extremely fine and artistically pleasing.

The book handling system includes a miniature cableway, making a tour of the book shelves and delivering books at the centre of the rotunda. The power for this cable system is an electric motor which hauls on a half-inch cable, and the section of the cableway is about two feet square. It is ex-



Generating Plant, Congressional Library, Washington, D. C.

pected that the delivery and return of books will be very expeditious and economical in other respects as well as in time.

INFLUENCE OF THE COMPOSITION OF THE CARBON OF THE ARC ON THE SPECTRUM OF REFLECTION.

BY L. B. MARKS.

In the valuable article by Dr. W. H. Birchmore on the "Spectrum of Reflection and the Efficient Illumination of Confined Space," published in The Electrical Engineer, Sept. 30, as well as in previous articles on the same subject, I note that Meyer's figures on the relative composition of different lights are taken as the basis of calculation. In applying the table for comparative purposes to the arc light, I find that the results are apt to be misleading, unless the figures are based on the performance of some special type of carbon electrode.

As pointed out by me in a paper on "Arc Carbons and the Rating of Arc Lamps," (Transactions National Electric Light Association, February, 1895), "the quality of the light as distinguished from its candle power must be carefully considered in the selection of a carbon, and in the proper operation of a lamp intended for a particular kind of illumination." A solid carbon will give entirely different results from a cored carbon; the constituency of the core, as is well known, has a very marked effect on the quality of the light. Moreover, even with the same carbons the composition of the light produced varies with different conditions of operation and is dependent on current and voltage of the arc.

These conditions cannot be overlooked in properly considering the relative values of the spectrum of reflection and the efficient illumination of confined space. If this information especially as to quality of electrodes were furnished in conjunction with the published table, the value of the results

as applied to the arc light would certainly be greatly enhanced.

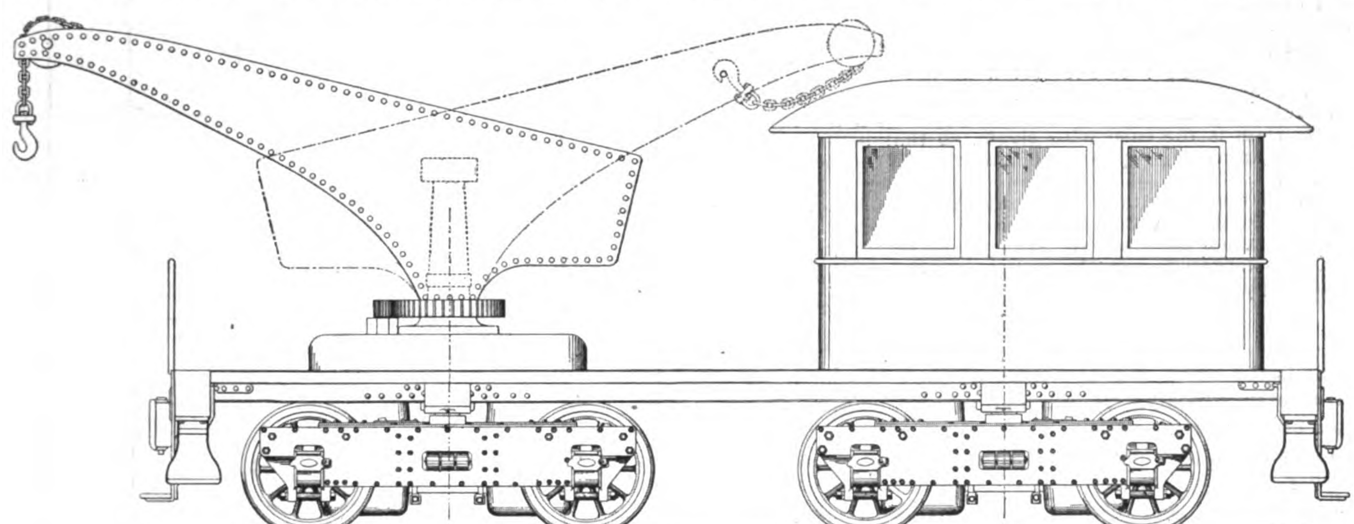
The ground taken by Mr. Marks is important and directly in line with my own studies; but in my published works no allusion has been made to the arc light as a method of illumination, my study having been confined exclusively to the filament (incandescent) lamp. In the quotation from Meyer's work the figures were given, and I quoted them as they stood, without comment, as I did not wish to mutilate the record. At some later day I shall perhaps have the time to do as Mr. Marks suggests; then I will give the data which, as he says, are so germane to the subject. W. H. BIRCHMORE.

ELECTRIC TRANSPORTATION.

COMBINED SWITCHING LOCOMOTIVE AND WRECKING CAR.

AMONG the electric railway rolling stock, which the Baldwin Locomotive Works are now prepared to build in conjunction with the Westinghouse Electric Company, is the combined switching and wrecking locomotive illustrated in the accompanying engraving.

This locomotive has the same fundamental features as the freight locomotive, namely, two trucks, one under each end, each truck being fitted with two motors, with a capacity varying from 50 to 200 horse-power each. These trucks are placed under a strong channel-iron frame, the length of which is made as short as possible, but in all cases permitting the trucks to clear each other on curves. The four-wheel switchers have the motors and axles fixed in a frame, rigid with the cab.



EIGHT-WHEEL ELECTRIC SWITCHING LOCOMOTIVE WITH ELECTRIC CRANE.

The locomotive has a crane at one end and a cab at the other. This crane is driven by an electric motor, and may have any required capacity. Switchers of this kind make excellent wrecking cars, and can be used in unloading freight.

THE JUNGFRAU ELECTRIC RAILWAY.

Having recently returned from the Wengernalp-Scheidegg, I send you some particulars as to the Jungfrau Railway, which will interest some of your readers and disgust others. At the Scheidegg Hotel I met the entrepreneur of this undertaking, M. Guyer-Zeller, who combines the functions which would in England be divided between the promoter, the directors, the engineer, the contractor, and the clerk of the works. His courage and enthusiasm are most remarkable, and his confidence in the success of his scheme is such that, of the £400,000 capital required, he has provided £40,000 out of his own pocket. He has now 150 men at work, and expects to finish this autumn the railway cutting and embankment from the Scheidegg to the Eiger. Last Thursday he finally fixed the point at which the tunneling will commence in the Eiger. The tunnel will be carried through the rock of this mountain, gradually ascending until it passes underneath the upper part of the Eiger glacier. The railway will next be taken through the Mönch until it reaches the Jungfrau, and in the rock of the Jungfrau itself the tunnel will gradually ascend to the top. Of the intermediate stations the first will be at the Eiger, the second on the Mönch, and the third near the Aletsch glacier—to which a branch tunnel will be made connecting the Bernese Oberland with the Rhone valley. The return fare from the Scheidegg to the top of the Jungfrau will be 54 francs, and it is anticipated that many persons who do not propose to go to the top will avail themselves of the intermediate stations in order to reach the Eiger or the Aletsch glacier.

The motive power will be electricity, generated by the waterfalls and streams at Lauterbrunnen and Grindelwald, from which 9,000 horse-power can be obtained. Only 3,000 horse-power is required, and it is proposed to utilize the residue for electric lighting at Berne, Thun and Interlaken.

M. Guyer-Zeller has no doubt that the cost will not exceed his estimate of £400,000, inasmuch as he personally superintends the works, and sees that no money is wasted. In six years he expects the railway to be finished. He will then be prepared to run a train every eight minutes, and he will keep a doctor at the bottom to advise passengers whether they are fit subjects for the ascent. This advice will be included in the 54 francs.—Arthur H. Spokes in "Westminster Gazette."

STORAGE BATTERY LOCOMOTIVES ON THE NEW YORK ELEVATED RAILROAD.

AS announced in our last issue, a storage battery locomotive was put in operation on the Thirty-fourth street branch of the Third avenue elevated railway. The locomtive has been in operation continuously since then, and its working is being closely watched by the railroad management.

It might at first sight appear that the storage battery locomotive could not compare in cost or efficiency with the operation of such a road directly from feeders without the storage battery, but the engineers of the Electric Storage Battery Co., who have undertaken to make this experiment on the elevated railroad, after exhaustive investigation are convinced that the advantages accruing by the use of storage batteries will prove this method far more economical than any direct feeder system alone.

If it were possible to so arrange matters that an average amount of power could be constantly supplied at an average distance from the station, a system of feeders could be installed which would concededly represent the most economical method of working a road like the New York Elevated. But it is this condition precisely which is never realized in practice; on the contrary, the nature of the traffic is such that the fluctuation of power is very great, and frequently bunching of trains occurs, which is as liable to happen at the further end of the road, as it is near the power station.

In order to successfully maintain the potential at the end of the line under such a condition of affairs, an enormous expenditure in copper for feeders would be required. It is just this ideal condition of drawing the average amount of power from the power station at an average distance from the station that the storage batteries of the locomotives are

designed to effect. It will be evident that no matter where the locomotive may be situated on a line so equipped, it will always have practically its full potential. At the farther end of the line the battery discharges more than it charges, while nearer to the power house it charges more than it discharges. The result is that the area of the conductor can be tapered more rapidly towards the farther end of the line.

Another point to be considered in this connection is that all batteries carried on the locomotives within a given distance, work in unison, so that, for instance, a train starting up from rest may, and probably will, draw current from the battery situated on trains ahead of and behind it, which trains may be at rest or coming to rest and thus be drawing no current from their batteries at that particular instant. As practically the major part of the power on elevated trains is consumed in the starting, the presence of the storage battery steadies the load on the engines at the station.

It may be argued that batteries might be distributed along the line of the road at regular intervals, which would accomplish the same object as batteries carried on the locomotive, but it will be seen that unless the number of these battery sections were very great the batteries themselves would have to be very large in order to take the maximum load which might come on any one section. Where the batteries are carried on the train itself, as in this case, no such condition can arise, as each storage battery locomotive could fully handle its own train, and, if necessary, carry it the full length of the road. It may also be argued that the same result could be obtained by placing the batteries at the power house. So far as steadying the load on the engine is concerned this would be true, but it is evident that a battery at the power house would not reduce the amount of copper required for distributing the current.

A number of other advantages are obtained by the equipment of the locomotive with an individual source of current; thus it will only be necessary to run the conductor on the straight portions of the road, no third rail being required at points where their presence would be objectionable, such as in car houses, at crossings, etc. It is calculated that with this equipment the acceleration obtainable with trains will be greater than is the case with steam, so that more trains can be run at an average speed, and hence trains can be run closer together.

With all these points of advantage in their favor, the Electric Storage Battery Company believe that they can prove to the satisfaction of the New York Elevated Railway officials that the storage battery locomotive is the most economical for their purpose.

TROLLEY HEART.

This is the name of a new disease which has made its appearance in Brooklyn, N. Y., and the following is a newspaper account of the pathology of and remedy for the disease, —as given by a physician who was interviewed on the subject: "Trolley heart is rather an indication that the nervous system is a leetle out of gear than an ailment by itself. All you need is to have your nervous system toned up a bit. You see, it comes from running the trolley cars at full speed one minute and stopping them short the next minute, and keeping up that alternation for a ride of two or three miles. The worst time for it is the rush hours at night. Then all the cars are behind time, and the motormen are trying to catch up to the time table and everybody is in a hurry to get home, and a group of people are standing on every corner waiting to get on the car. The motorman starts the car at full speed, and the sudden rush forward causes a shock to the nervous center about the pit of the stomach, which makes a sudden effort to adapt itself to the situation. Then, just as soon as the nerves have been regulated to top speed, they receive another wrench as the motorman stops the car short to let more passengers on. Thus there is a sudden strain, a sudden relaxation, and then another wrench on the nerves. It's like catching a boy by the scruff of the neck and shaking the life out of him. Apply this quick alternation of sudden starting and sudden stopping to a man whose nerves have been at high tension at his work all day and you get a wreck. The proper way for a man to go home after his work is calmly, evenly, smoothly, not by starts and jerks. That's the way trolley heart is started. Why, I have a patient who was the best father and husband in the world until they put in the trolley. After a year of it he was attacked with trolley heart, and when he'd get home at night he'd be in such a state of nervous irritation that his family couldn't stand him, and his wife was seriously thinking of suing for divorce."

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—IV.

BY LIEUT. B. A. FISKE, U. S. N.

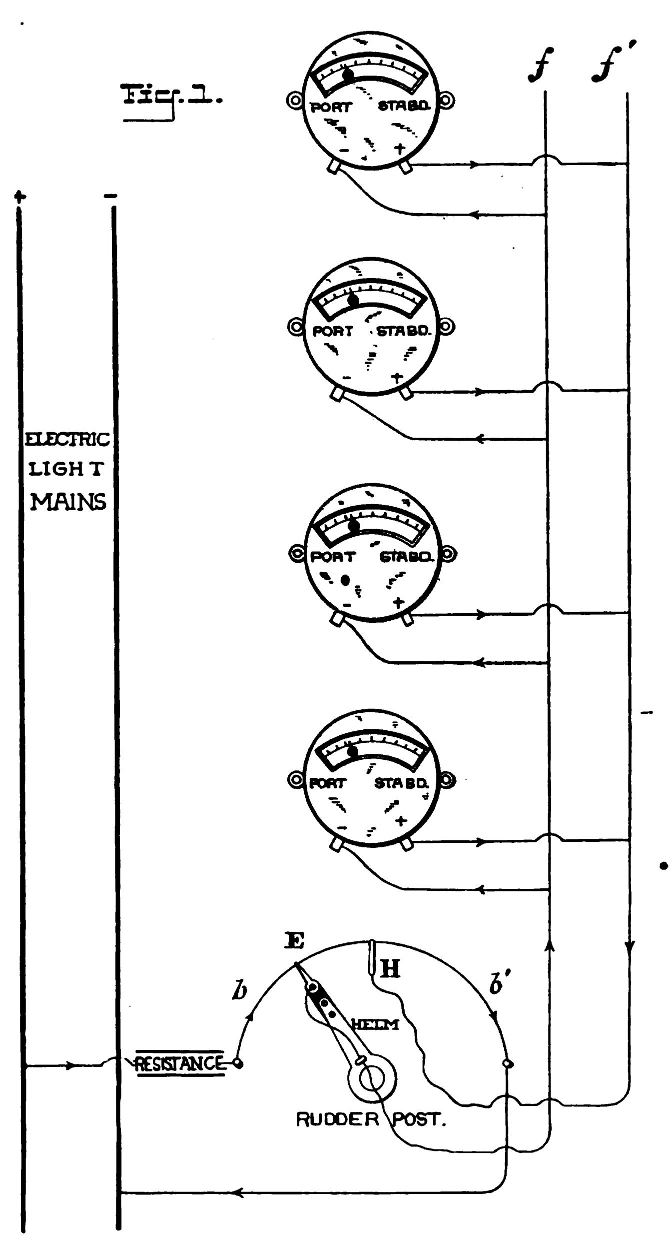
THE HELM INDICATOR.

THE office of this instrument is to indicate instantly, at certain places in a ship, the exact position of the helm. This is accomplished by means of a device rigidly secured to the rudder post, and electrically connected to any desired number of indicators.

The device secured to the rudder post consists of a strip of

HELM INDICATOR

DIAGRAM OF ELECTRICAL CONNECTIONS.



resistance wire, through which an electric current is passing and over which a metallic contact is moved by the helm; the indicators are galvanometers whose needles deflect to the right and left as the helm moves the traveling contact to starboard and port on the strip of resistance wire, the amount of the movement of said needles being proportional to the amount of movement of the helm and of the contact moved by the helm.

The principle of operation of the helm indicator is shown diagrammatically in Fig. 1. Attached to the helm and in-

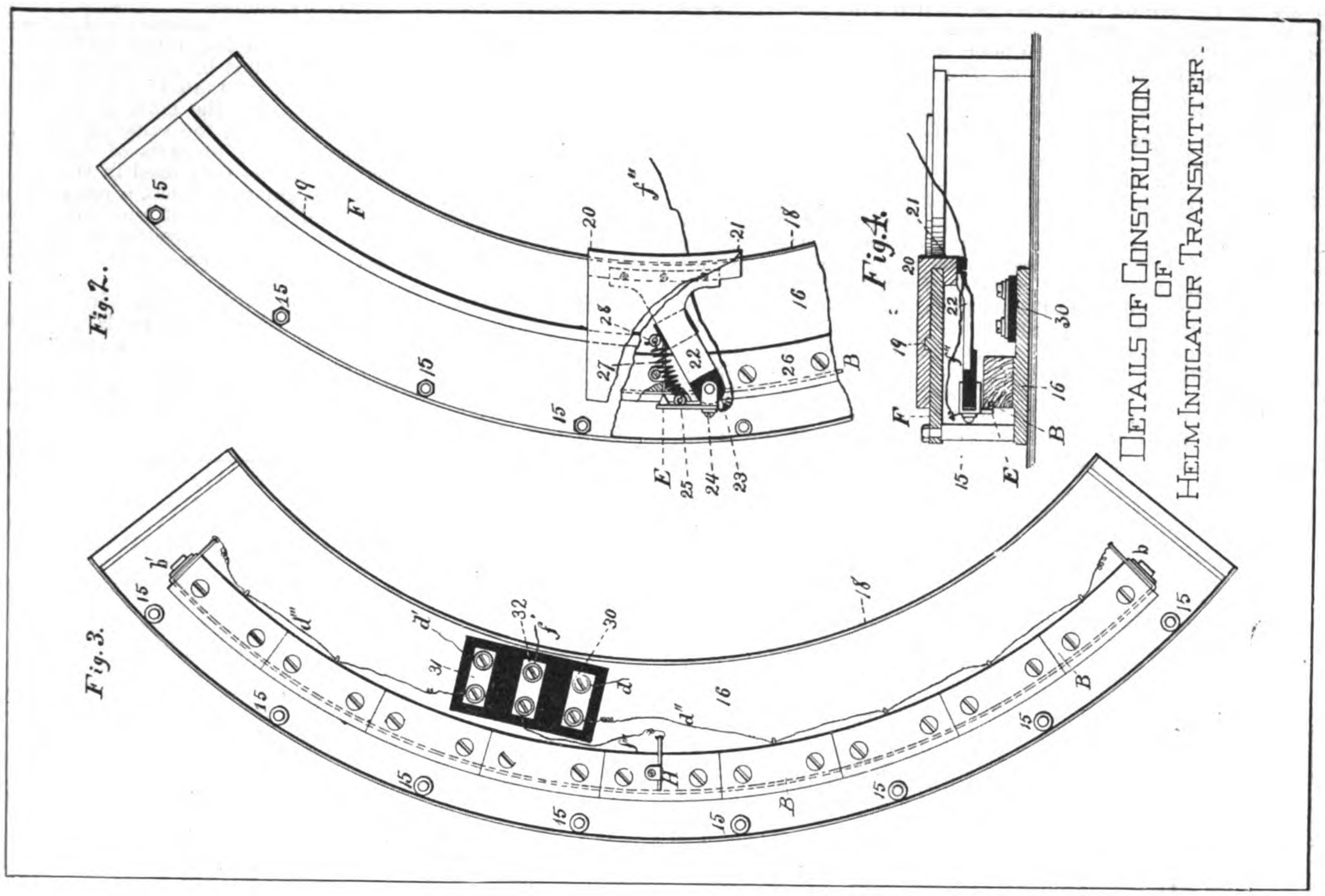
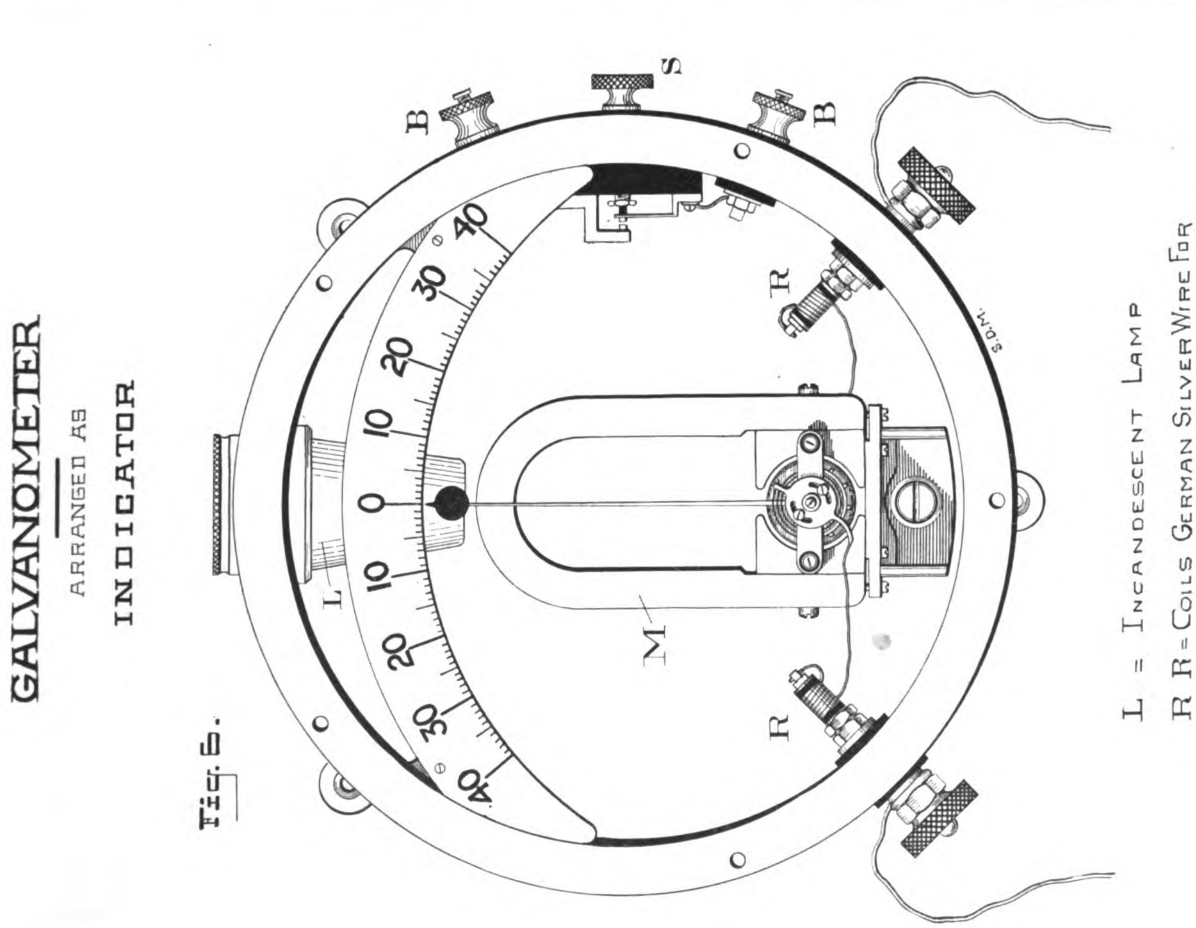


Fig. 2.
Fig. 3.
Fig. 4.
DETAILS OF CONSTRUCTION OF HELM INDICATOR TRANSMITTER.

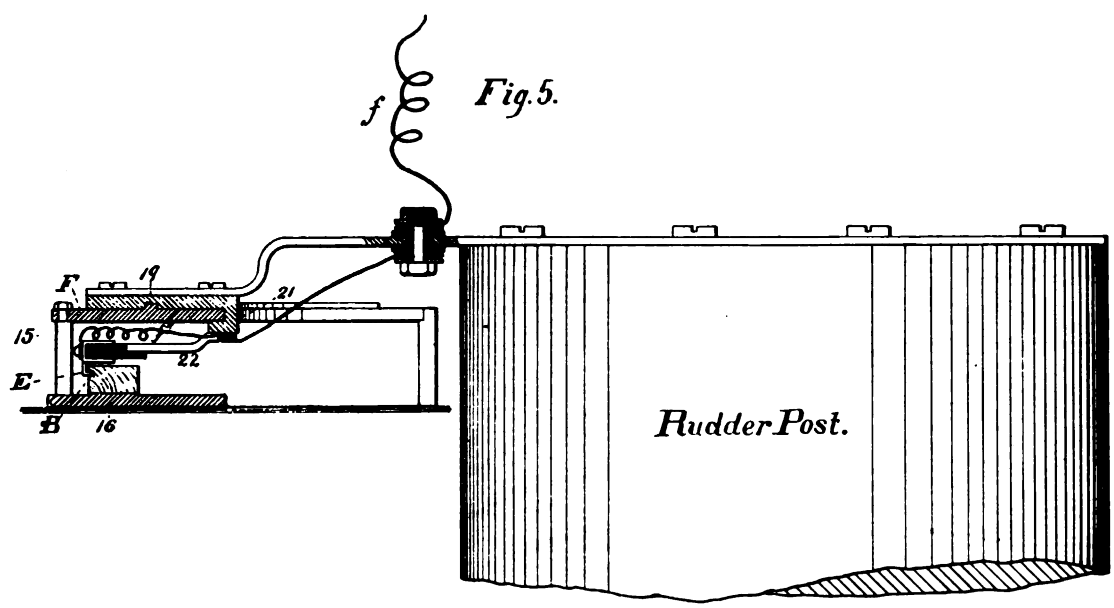

GALVANOMETER
ARRANGED AS
INDICATOR
FIG. 5.
L = INCANDESCENT LAMP
R R = COILS GERMAN SILVER WIRE FOR ADJUSTING SENSITIVENESS OF GALVANOMETER

sulated from it is the metallic contact E, which continually presses on the arc of resistance wire b b'. At the middle of this arc of resistance wire is secured and soldered a permanent metallic contact H. When the helm is amidships the traveling contact E rests on the permanent contact H, but it is moved to starboard and port of it by the movements of the helm.

A current of electricity continually passes through the resistance wire b b'. The current may be furnished by any suitable generator, such as a storage battery, primary battery, dynamotor, etc., but in the diagram it is shown as coming from the ordinary electric light mains of the ship, a suitable rheostat (resistance) being interposed to reduce the current to about 2 amperes. The immediate cause of any current in a wire being a difference of electric pressure (or potential) between the ends of the wire, it follows that there is a difference in pressure between any two points on the wire; so that if a galvanometer be connected to any two points on the wire, a current will be diverted through the galvanometer, going from the point of higher potential to the point of lower potential. In Fig. 1, as the current in the wire b b' is going from left to right, as shown by the arrow-heads, the point at E is at a higher pressure than the point at H, so that any galvanometer connected compared with that of each galvanometer, an accident to any galvanometer will not materially change the total amount of current. The current in any one galvanometer, and therefore its deflection, will increase slightly if any other galvanometer be injured and its current broken, but by an amount that is scarcely perceptible, never being more than 1° when the helm is hard over, and being nothing when the helm is amidships.

The resistance wire ordinarily used is the same as that used in the Fiske range-finder—an alloy of 70 parts of copper and 30 of nickel, nearly the same alloy as that used in the United States 5 cent piece. It is No. 22 gauge and has a resistance of about ⅛ ohm per foot. It is laid in an arc, of which the center is the center of the rudder post and the radius is about 22 inches; the radius may be varied, of course, to suit different places.

In the apparatus constructed for carrying the wire b b' and the contacts, called the transmitter, the wire is laid in a groove in an arc of wood, which is secured on a curved base plate of metal and covered by a similar curved piece of metal. The details of construction are shown in Figs. 2, 3 and 4; and Fig. 5 shows the method of securing the transmitter to the rudder post.



METHOD OF CONNECTING HELM INDICATOR TRANSMITTER TO RUDDER POST.

to E and H will be traversed by an electric current in the direction shown by the arrow-heads and the needle will move to the left. If, however, the contact E were to the right of H, it would press on a point on the wire which had a lower pressure than H, so that the current would flow through the galvanometer in a reverse direction from that indicated in the diagram and the needle would move to the right. If the contact E rested on H, as it does when the helm is amidships, the contacts E and H would have exactly the same pressure, and no current would flow through the galvanometer, and the needle would not deflect. In the galvanometers employed for this purpose, the position of rest of the needle is at a zero point in the middle of the scale.

In Fig. 1 there are four galvanometers connected in parallel (or multiple arc) to the wires f and f' which come from the contacts E and H. The reason for not connecting the galvanometers in series is that an accident to any galvanometer in action, or at any other time, would break the circuit and no galvanometer would operate. But if the galvanometers are connected in parallel, as shown, and if the wires f and f' are led below the protective deck, any accident to any galvanometer, or its leading wires, will cripple that galvanometer only. As the resistance of each galvanometer is about 60 ohms, and as the wires f and f' are of copper about No. 16 gauge, and the resistance of the wire b b' is extremely small

Referring to Figs. 2, 3, 4 and 5, the guide F is a curved plate of metal, supported by standards, 15, which rise from a base plate, 16. The plate 16, guide F and standards 15 form a box, or case, for the arc of wood, B, and movable contact point, E. Upon the upper side of the guide F is a rib, 19, which enters a groove in the under side of the traveling plate, 20. This plate has a flange, 21, which extends around the edge of the guide F. To the plate, 20, the tiller of the rudder is directly connected, so that, as the rudder is swung from one side to the other, the tiller will move the plate, 20, over the guide, F. Or any suitable intermediate transmitting mechanism may be interposed between rudder and plate, 20, to cause the stated motion of said plate and contact.

Note.—In case a needle gets bent it may be straightened with the fingers. But if, when at rest, it does not point to 0, and yet is straight, the trouble is that the little clamping screws near its pivot, shown in Fig. 6, have slipped. In this case these screws must be slackened and the needle turned carefully on its pivot until it points correctly, and then the little screws re-tightened.

Note.—Fig. 6 shows coils of resistance wire inside of the case for adjusting the sensitiveness of the galvanometer. Where extreme accuracy is required it becomes necessary to have an adjustable resistance outside the case as in the Fiske range-indicator, in order to compensate for sudden variations in the strength of the magnet due to changes of temperature. But this refinement is not considered necessary in helm indicators or steering telegraphs.

Weight of transmitter, 35 pounds; weight of indicator, 22 pounds; diameter, 10 inches; resistance, 60 ohms.

To the flange, 21, is secured an arm, 22, the end, 23, of which is of insulating material and carries a pivoted bracket, 24, which supports a short arm, 25, on the end of which is the contact point E. The arc, b b', of resistance wire is embedded in a groove in the edge of the wooden arc, B, which is secured by screws to the upper side of base plate, 16. Also to said blocks is secured the fixed contact point H. A spiral spring, 27, connected to the arm, 25, and to an eye, 28, held in an insulating block on arm 22, serves to hold the contact point E against the resistance wire b b'.

The wires d and d' are secured to plates 30 and 31, and from those plates the wires d'' and d''' lead to the terminals of the resistance b b'. The wire f' connects to a similar plate, 32, and from this plate the wire f''' leads to the fixed contact H. The wire f, Fig. 5, is connected to a plate on the arm extending from the rudder post to the traveling plate, 20, and from this plate the wire f'' leads to the contact piece E.

The resistance wire b b' should be kept covered with a thin film of oil or vaseline. If this is done the friction of the traveling contacts will not cause the wearing away of the contacts or the wire, and the contact will move smoothly without jumping.

In case of trouble with this apparatus, the cause will be found in nine cases in ten to be a faulty contact.

In some cases the details of the transmitter have to be changed slightly in order to make it fit in certain places; for instance, the sliding plate, 20, sometimes has a flange fitting around the outside edge of the base plate, 16, instead of around the inside edge.

The galvanometer usually employed in the helm indicator, steering telegraph and engine telegraph is like that used in the Fiske range-finder and range-indicator and is illustrated in Fig. 6. The current passes through a light coil of wire in the form of a bobbin pivoted between the poles of a stout magnet, M. It is held normally at a position of rest in the middle of the scale by two spiral or volute springs, one at each end of the pivot. The effect of a current going through the coil of wire is to turn the coil in one direction or the other according to the direction of the current, and this tendency is resisted by the springs, so that the needle assumes a resultant position, in which the force of the springs just balances the magnetic force operating between the magnet and the current, the movement being small or great according as the current is small or great.

The galvanometer is mounted in a heavy water-tight case. In the helm indicator and steering telegraph circuits, the cases are usually made of heavily japanned cast iron, both for strength and for the reason that the iron case acts as an armature to the magnet inside, and decreases the effect of the magnet on any compass in the vicinity. But an indicator should not, if possible, be closer to a compass than three feet.

The iron cover carries under it a strong circular plate of glass, held on to it by an iron ring. The circumference of the glass is encircled by a rubber band, between which and the glass, white lead is placed to insure water-tightness. For the same purpose, white lead is thickly laid in the grooves for the glass plate in the cover and the iron ring, so that, when the iron ring is screwed on to the cover (the glass being between), the complete cover thus formed is itself water-tight. Before screwing the cover on to the galvanometer case, a rubber gasket is secured to the case by shellac. When the cover is screwed on, it forces the gasket into such intimate contact with the case that it cannot afterwards be pulled off without tearing. Shellac and white lead are omitted between the cover and the rubber gasket, in order to make it easy to take off the cover, if it becomes necessary. To make the case water-tight, therefore, the cover must be screwed on tight.

A space of about $^1/_{32}$ inch is left between the glass and the outer iron plate in order to protect the glass against any blow that might be transmitted through the iron plate. To drain off any water that might run in between the glass plate and the iron plate, a quarter-inch hole is cut near the lower part of the iron plate. The helm indicator was given a year's test in service on board the armored cruiser New York. It has since been installed in the battleships Indiana and Massachusetts, using five indicators in each ship, the year's test having been passed successfully. It is now being installed in the Texas and is to be installed in the Brooklyn.

To illuminate the indicators of the helm indicator and steering telegraph for night use, a small electric lamp L is introduced into the case as shown in Fig. 6. It lies within a stationary water-tight glass receiver, or globe, so that it can be taken out for inspection when desired, and replaced by another lamp, if necessary. The lamp may be lit by the current from a storage battery, or from the electric light mains of the ship, connected to the binding posts, BB, resistance being interposed to cut the current down to about ⅓ ampere. The lamp is lighted by turning the water-tight switch shown at S, Fig. 6. The scale is printed on cardboard secured on a brass gauze translucent backing.

The copper wires connecting the instruments should not be less in size than No. 16 American gauge.

ALTERNATE CURRENT TRANSFORMERS.—IX.

BY DR. J. A. FLEMING, F. R. S.

(Concluded.)

THE following table shows us that practically the largest conductor which should be used in connection with alternating current work is a cable having an outside diameter equal to a 19/12 cable, and that if the cable has a greater diameter, then its resistance to alternating currents of a frequency 100 is sensibly different from its resistance to continuous currents. In the next place, with regard to capacity, suppose that a concentric cable is formed by putting one cylindrical tube in the interior of another cylindrical tube, the space between the tubes being occupied by non-conducting material or dielectric having a specific inductive capacity equal to K; then, if R_0 is the radius of the inside of the outside tube, and R_1 is equal to the radius of the outside of the inner tube, and if L is the length of the tubes, the capacity of this concentric cable in microfarads is given by this expression:

$$C = \frac{KL}{2(\log R_0 - \log R_1)} \cdot \frac{1}{2{\cdot}303 \times 10^5}$$

Then, as regards the value of K for paper insulation, such as is used in the Ferranti cables, K has a value very nearly equal to 3; but, if India-rubber is used, then K has a value very nearly equal to 4. On calculating out these values for most ordinary cables used for the conveyance of high tension alternating currents, it will be found that for such insulating materials as paper, Fowler-Waring composition, or various resinous substances, the capacity of the cable is generally about one-third of a microfarad per mile.

TABLE OF RESISTANCE OF HIGH CONDUCTIVITY ROUND COPPER CONDUCTORS.[1]

Cable. Strands and size.	Total cross-section area in square inches.	Resistance in ohms per 1,000 yards. For continuous currents.	For alternating currents. Frequency 100 ~ per second.
7/18	.0126	1.974	1.974
7/17	.0172	1.452	1.452
7/16	.0225	1.108	1.108
7/15	.0285	.878	.878
7/14	.0351	.712	.712
19/18	.0351	.712	.711
19/17	.0477	.524	.524
19/16	.0624	.401	.401
19/15	.0789	.318	.318
19/14	.0973	.257	.257
19/13	.1289	.194	.195
19/12	.1645	.153	.155
19/11	.2048	.122	.1247
19/10	.2500	.100	.1034
37/16	.1227	.204	.2041
37/15	.1551	.162	.164
37/14	.1913	.131	.1334
37/13	.2534	.099	.1024
37/—	.3000	.083	.087
37/12	.3235	.077	.081
37/11	.4000	.063	.068
37/10	.4905	.051	.057
61/15	.2582	.097	.1004
61/14	.3185	.078	.082
61/13	.4218	.060	.065
61/—	.5000	.050	.056
61/12	.5385	.046	.052
61/—	.6000	.041	.048
61/11	.6476	.039	.0465
61/—	.7000	.0357	.0435
61/10	.8167	.0305	.0391
91/13	.6354	.0385	.0458
91/—	.7500	.0330	.0412
91/12	.8111	.0305	.0391
91/—	.9000	.0277	.0370
91/11	1.0000	.0250	.0350

From what has been said above with regard to the resistance effect, it must be noted that in the construction of a concentric cable the maximum thickness of the copper conductor cannot be more than about ½ inch. In cases where larger currents have to be conveyed than can be carried through the

[1] The wire numbers are given in British Standard Gauge.

equivalent of a 19/12 cable, it is desirable to employ two concentric cables in parallel. Let us consider, then, the capacity effects. If a long concentric cable is connected to an alternator, the far end of the concentric cable being insulated, it is found that an electric current flows into and out of the cable, which may be sufficient to light one or more incandescent lamps. This is called the capacity current of the cable, and it is a current flowing across the dielectric or non-conductor from one copper member to the other. If C is the capacity of the cable measured in microfarads, V, the difference of potential between the two copper members measured in volts, and if P represents $2 \pi n$, where n is the frequency, then the capacity current, I, is given by this expression:

$$I = \frac{C, p, V}{10^6}.$$

Thus, for example, supposing a cable, having a capacity current one-third of a mile capacity, has a potential difference of 2,000 volts between its inner and outer conductors, and P equals 500, then the capacity current is one-third of an ampere, or equivalent to the lighting current of one 8-candle-power lamp. Hence, in very large concentric systems, this capacity current going out of the station may amount to a considerable value. We have then to consider briefly what are called the resonance effects. If an alternator is separately excited so as to give a certain potential difference at its terminals, suppose 2,000 volts, and if a long length of concentric cable is connected to this alternator, the far end of the cable being insulated, then it will be found that such cable, when associated with the alternator, may greatly increase the electric pressure between the terminals of the alternator, and that for a certain critical length of the cable a very marked rise in pressure may take place. The same will be found to be the case if a long length of concentric cable is connected to the high pressure side of a step-up transformer being excited from a 100-volt alternating circuit on the low pressure side. Accordingly, in testing concentric cables, the engineer must always be on his guard against this resonance effect. Suppose, for instance, it is desired to test whether a certain length of concentric cable will stand 2,000 volts, the most natural method of doing this would be to connect the high pressure side of a step-up transformer, raising the volts from 100 to 2,000, and to serve the low pressure side of this transformer from a 100-volt circuit. The inexperienced person might naturally suppose that this would invariably place upon the cable a pressure of 2,000 volts, but under certain conditions, depending upon the capacity of the cable and the inductance of the transformer, the pressure might rise far beyond 2,000 volts between the two members of the cable, and the only method of making sure that this is not the case is to have an electrostatic voltmeter kept connected between the inner and outer members of the cable as the pressure is gradually increased. Then, in the last place, not only are there the resonance effects above referred to, by which a concentric cable when switched on to an alternator or transformer permanently raises the pressure, unless the exciting current of the alternator is reduced, but there are certain very important initial effects which take place at the moment when a concentric cable is switched into connection with either an alternator or another live cable. If a condenser is connected with an inductive resistance, it can be shown that at the moment when this system is brought into connection with the source of alternating electromotive force, if the connection is made at a particular instant with respect to the phase of the electromotive force, there is an electrical oscillation set up in the combined condenser and inductive resistance, the amplitude of the oscillations of current greatly exceeding those which would exist when the steady state has been established, and oscillations of potential difference occur at the same time, the result of which is that the difference of potential between the two plates of the condenser will undergo a periodic change, the amplitude of the oscillations of which is, however, in the initial stage much greater than that of those which take place when the whole system has settled down into a steady condition under the influence of the impressed periodic electromotive force. Suppose, then, that a series of transformers are connected to the two copper members of a concentric cable, and that the concentric cable is, as usual, lead covered and steel armored, with a layer of insulation between the lead covering and the outer copper members. As already stated, there is a certain capacity in the concentric cable between the inner and the outer members, which will be generally something like one-third of a microfarad a mile, but, at the same time, there will be a capacity between the outer member of the concentric cable and the lead casing or the earth; and this capacity between outer and the earth, as it is called, is very much larger in general than the capacity between the inner and outer; it may be ten times as great. Hence, if the transformers are connected between the inner and outer conductors we may regard the primary circuits of the transformers, which are inductive circuits, as connected in series with a condenser, which is formed of the outer members of the cable and the lead covering. If, therefore, such a cable, with transformers attached to it, the secondary circuits of which are unloaded, is switched into connection with the omnibus bars of an alternating current station, the connection between the inner member of the cable with the proper omnibus bar being made first, then, at that instant, an electromotive force is impressed upon the system, consisting of the inductive primary circuits and the condenser in series with them. For a particular phase of the impressed electromotive force, it can be shown that oscillations of potential are set up in the condenser, causing a periodic potential difference between its two sides to be greater than that due to the steady action of the periodic electromotive force. This sometimes results in breaking down the insulation between the outer members of the concentric cable and the lead covering, and as this insulation is generally in all cases made much thinner than that between the inner and outer members of the cable it is not unfrequently pierced. Alternating current station engineers are very familiar with failures of such concentric cables occurring between the outer members of the cable and the earth. The remedy for this is one of two things, first, the outer the concentric cable must be connected to its proper omnibus bar first before the inner member of that concentric cable is connected. If this is done, then it is impossible to set up destructive oscillations of pressure between the outer members of the cable and the lead covering. Another remedy is to introduce in the circuit with the inner member of the concentric cable a variable inductance, which is gradually removed in such fashion that the inner member of the concentric cable is not connected suddenly with the source of potential, but is connected through a choking coil, the choking quality of which is gradually removed. This can be done in the following manner: A large transformer is arranged so that its secondary circuit can be gradually short-circuited by lowering two lead or iron plates into an insulated tub of water; the primary circuit of this transformer can be connected in series with the inner member of the concentric cable, which is to be brought into connection with the system. The operation, then, of connecting the long concentric cable to the omnibus bars is as follows: The series transformer first has its secondary circuit opened, its primary coil is then connected in series with the inner members of the concentric cable to be connected, and with the proper omnibus bar, the outer member of the concentric cable is then connected with the other omnibus bars; the plates on the secondary circuit of the series transformer are then gradually lowered into the water, and when the secondary circuit of this series transformer is practically short-circuited the primary circuit of the transformer is also short-circuited, and the transformer is then removed, leaving the main in connection with the omnibus bars. The operation, moreover, is performed in such a manner that there is no rush of current into the cable, and no possibility of setting up violent oscillations of potential between the outer members of the concentric cable and the earth. In no case should long concentric bars be connected to omnibus bars, or to other parts of an alternating current system without some such process as the above, of gradually setting up the full current in them, or else the risk of piercing the outer insulation of the concentric cable is very considerable. Engineers, in connection with alternating current stations, should always be on their guard against these initial effects, and remember that long concentric cables, with transformers connected to them, possess a quality which resembles inertia, and that currents can no more be started and stopped instantly in these cables and transformers than heavy machinery can be started and stopped at once.

In addition to the initial effects taking place in cables, I showed, in 1892, that there were certain initial effects, called current rushes, taking place in transformers when suddenly switched into connection with a live cable. Under some circumstances, depending upon the phase of the electromotive force in which the switch is closed, a strong rush of current may take place into the primary circuit of a transformer, the maximum value of that current rising to twice the maximum value of the current when the steady state is established; and, under some conditions, in switching off a transformer, there may be a certain rise in the difference of potential between the parts of the primary circuit and the iron case or secondary circuit which may pierce the insulation. If a large current is flowing in an inductive circuit, and a switch is suddenly opened, interrupting that circuit at an instant when the current has its maximum value, then a large inductive electromotive force is set up in that circuit, which may result in breaking down the insulation between parts of that circuit.

The effect arises from the same cause that frequently destroys the insulation of a field magnet of a continuous current motor or dynamo if the field magnet is suddenly switched off at a moment when the magnet is in a state of excitation. Broadly speaking, as a practical rule, it should be remembered that long concentric cables, having transformers lightly loaded connected to their ends, should never be suddenly switched into connection with alternators, or switched off, but should always be put into connection with the source of electromotive force through a regulating resistance or inductance, so arranged as to prevent or check the formation of any oscillations of current other than those due to the natural period of the impressed electromotive force. In the early days of the working of many large alternate current stations, many difficulties were experienced, owing to the failure of large transformers, and the piercing of long concentric cables, which were due to these causes; but experience has now shown how to overcome these difficulties, and to prevent any of these disastrous initial effects. In many cases cables and transformers, which suddenly fail when switched into connection with the circuit, after being idle for a time, have really been injured at the instant when they were last switched out of connection with the working system, owing to the rise of potential that has taken place at the instant when the current was interrupted at a particular instant during its phase. Hence the removal of a cable from a working system at the omnibus bar, or at any intermediate point, must always be effected with the same care as the connection of a cable, and in no case should a long concentric cable, whether connected to transformers or not, be switched on or switched off from the live omnibus bars of the station abruptly. This, of course, does not apply so much to short lengths of a few hundred yards as to long lengths of one or more miles; but it behoves the engineer always to be on his guard against these sources of failure.

The time will not allow me now to develop at any greater length these points, and in closing this brief discussion on the construction and action of transformers, there is no need to emphasize the fact that much has perforce been omitted, owing to the limits of our time, which a complete treatment would necessarily include. I have endeavored to direct attention rather to a few principal practical considerations, and to portions of the subject not quite elementary in character, and to assume, as I said at the beginning, that the fundamental principles were already familiar to most present.

Great as has been the progress in ten years in alternate current working, no one would be so rash to assume that we have reached the limit of its improvement. The practical perfection of the transformer placed in the hands of electrical engineers an instrument of enormous utility and power for effecting the distribution of electric current. Large as may be our indebtedness to those whose scientific and constructive ingenuity has brought about this advance, we must at the same time remember, with due meed of honor and praise, the pioneering experiments of Paul Jablockoff and Lucien Gaulard, in 1887 and 1882, which, even if not the first suggestions for the employment of the induction coil in electric lighting, certainly forced the attention of engineers to consider closely the value and use of that device, and the service it might be brought to render in the solution of the problems of public and private electric supply.

ELECTRIC SEALSKIN.

The first consignments of sealskins reached London, now the greatest market and distributing center of the world's yearly crop of fur, a few weeks since, but the sales are not likely to be held before December. Although the skins from British Columbia and the Behring Sea, as well as from the Prybilov and Copper Islands, are much smaller than those of last year, it is quite possible that prices will not be raised in proportion to the depreciated catch. This is largely due to the fact that what is called "electric seal" has found its way into common use to such an extent that the value of true sealskin has become lessened in the eyes of the furriers' fair customers.

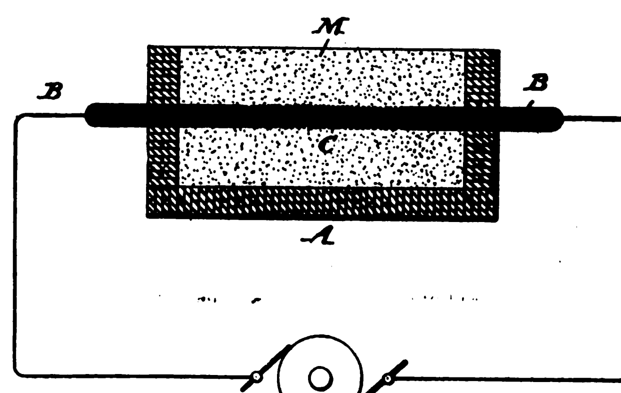
Electric seal is nothing more than the skin of the ordinary French tame rabbit scientifically treated. The skins are first dressed to obtain pliability and softness, the coat afterward passing under a machine of extraordinary delicacy, which shears down the stronger and coarser hairs, giving at the same time a softness and "flow" to what is left. The dyeing is skilfully managed to give artful gradations of golden brown under the surface, while the final stage of manipulation is assisted by electricity, really marvellous machinery removing any undesirably stiff hairs that may have been left by the first machine. It is curious that only the skin of the domestic rabbit can be so treated.

I am told by one who ought to know that sable and ermine, as well as chinchilla, will, this coming season, dispute the supremacy of sealskin. No successful imitation of the rare Russian sables has yet been found, and it is likely that these beautiful skins will bring a more exorbitant price than ever this year.—"Philadelphia Public Ledger."

GRAPHITE FROM THE ELECTRIC FURNACE.

ONE of the most remarkable as well as useful of the products of the electric furnace which has reached the stage of commercial availability is the well known carborundum of Mr. E. G. Acheson, now being extensively manufactured by the Carborundum Company, at Niagara Falls. From the beginning of his experiments in the production of carborundum, which is a silicide of carbon, Mr. Acheson noticed the formation of graphite among the products of the carborundum furnace, but the quantities formed, though of great purity, were comparatively small. Encouraged by these results Mr. Acheson proceeded to investigate the conditions under which graphite is formed in the carborundum furnace, and as a result of this work he is now enabled to produce this valuable material in any desired quantities.

In converting carbon in its ordinary conditions as found in commerce and in nature into pure graphite by subjecting the carbonaceous material to a high temperature, such as is obtained in an electric furnace, it would naturally seem that



ACHESON'S METHOD OF PRODUCING GRAPHITE IN THE ELECTRIC FURNACE.

the purer the carbon used in charging the furnace the more abundant would be the yield, and it would perhaps be generally considered that there was a direct transformation or conversion of the carbon into graphite. Mr. Acheson has discovered, however, that such is not the case, and that the percentage of graphite produced by highly heating pure carbon in an electrical furnace is insignificant and impracticable. He has also discovered that in order to produce pure graphite from carbonaceous materials there is an indirect conversion, and that the act of formation of the graphite is more in the nature of an act of dissociation of the carbon from its combination with other materials than a conversion of the ordinary carbon into graphite, and that as a preliminary step the carbon has to be combined chemically with some other material. Thus he has found that if the carbonaceous material or carbon used in the process contain a considerable proportion of mineral matter, or if it is mixed with a certain proportion of oxid, such as that of silica, clay, alumina, magnesia, lime or oxid of iron, etc., and subjected to the treatment described below, the yield of graphite is enormously increased and the product is most satisfactory.

The accompanying diagram represents graphically a longitudinal vertical section through the center of the furnace, A, built of firebrick. Carbon rods, B B, connected with the source of electric energy, pass through the end walls of the furnace; a granular carbon-core, C, extends the length of the furnace between the carbon rods, and this core is surrounded by the mixture, M, of carbonaceous material and oxids, out of which mixture the graphite is to be produced.

The mixture, M, is composed of powdered coke, sand, salt and sawdust, the coke forming about fifty per cent., by weight, of the mixture, and these materials are thoroughly mixed and introduced into the electric furnace surrounding the core of granular coke, which is of sufficient size to conduct the current through the mixture at the beginning of the operation and until the graphite is formed in sufficient quantity to act as a conductor of the current. The furnace being

thus prepared, the current is turned into it with an amperage sufficient to impart to the core the requisite heat. As the temperature rises, the resistance of the core decreases, and thereby more current passes through it. The size of the core and the current strength must be sufficient and so proportioned as to raise the temperature of the core to a point where the portions of the mixture immediately surrounding it will be subjected to the chemical and other changes necessary for the production of the graphite out of the carbon or coke contained in the mixture of carbon and silica. As the temperature of the core rises the heat radiating therefrom passes into the mixture, and the carbon unites with the silicon of the sand to form a carbid of silicon. When this chemical combination takes place, there is formed around the core a layer of amorphous and crystalline carbid of silicon or silicide of carbon, which in its crystalline form is called carborundum, and as this process continues this layer or zone of carborundum is gradually increased.

Upon continuing the application of the electric current, producing a very high temperature, much higher than is necessary for the formation of the silicide of carbon or carborundum, the carbon is dissociated or separated from the carbid of silicon into the graphite form, while the silicon is volatilized and passes off in the form of vapor. As the destruction of the carbid goes on and the graphite is formed around the core the graphite becomes a conductor and the core is increased as the graphite is formed, so that the intense heat necessary to the production of the graphite is transmitted to the surrounding carbid, and more carbid is destroyed and graphite deposited on the core until the graphite formation has extended outward to a point so close to the walls of the furnace as to endanger them from the intense heat produced.

The process may thus be said to embody a complete cycle, by means of which pure carbon in its amorphous condition is converted into free pure carbon in its graphitic form, and in accomplishing this the amorphous carbon is first caused to form a chemical union with one or more elementary bodies, as the silicon, and this chemical compound is then disassociated or separated into its elements, the carbon assuming the graphitic form and the elementary body, as the silicon, being volatilized.

Mr. Acheson has found that when in carrying out this process a carbonaceous material is used containing an unusual amount of ash the oxid added should be correspondingly diminished, and if the carbonaceous material is so impure as to contain more than the requisite proportion of foreign matter a proper charge may be made by the addition to such impure carbonaceous material of a sufficient amount of ordinary hard coal, coke, or the like. He has found it also advisable to use a carbonaceous material containing as little volatile matter as practicable, as when such material is present energy is wasted on destructive distillation.

Various strengths and conditions of current may be used. As an example, with the graphite furnace indicated, having a core seven feet long by four inches wide, composed of granular coke or carbon, the current at starting is about six hundred and fifty volts and fifty amperes. As the graphite is formed and becomes a conductor, extending the core, there is a change, say, to one hundred volts and one thousand amperes before the completion of the run or operation and the production of the entire amount of graphite.

THE DE LAVAL ELECTRIC IRON SMELTING PROCESS.

We print below an interesting account of the new process for reducing iron directly from its ores by the electric arc, communicated to "The Iron Age" by Mr. F. H. Daniels, general superintendent of the Washburn & Moen Manufacturing Company, who has returned from a trip to Europe, which included a visit to Sweden:

Dr. De Laval has become one of the best known Swedes and is regarded as their greatest mechanical and metallurgical genius. He is perhaps best known to the general public as the inventor of the separator for extracting cream from milk and as the inventor of the De Laval steam turbine. He has also lately brought out the lactator, a machine for milking cows, which is in successful operation near Stockholm. His most recent undertaking in the direction of reducing iron ore to metallic iron by means of an electric arc has excited widespread curiosity through Europe, especially so in Sweden. The fact that Dr. De Laval has been in the past a very successful inventor and that his inventions have returned large revenues, both to himself and his associates, leads many conservative engineers in Sweden to believe that his experiments have already been or will be successful, and that the final outcome will be a successful and commercial process for reducing iron ore directly to metallic iron or steel. It is stated on good authority that a company has already been formed, with a capital of 20,000,000 kronor, and that Dr. De Laval's financial backing is already assured, the most largely interested being men whose names are well known all over the world. Dr. De Laval commenced his experiments something like three years ago at Trollhattan. During this period he has been assisted by a competent corps of mechanical engineers and metallurgists, and it is evident these experiments have produced results, from the fact that he has purchased one side of the entire water power at Trollhattan, which is made up of four falls, an aggregate horse-power of from 60,000 to 70,000. He has also purchased at considerable expense very much larger water powers in the North of Sweden.

It is interesting in this connection to note that quite a number of the iron and steel works in Sweden have become so interested in the possibilities of this process that they have purchased all of the available water power in their vicinity. It is a matter of fact that water falls are in demand at the present time in Sweden, and in favorable localities can be disposed of on very advantageous terms.

It is understood that this process does not contemplate the manufacture of iron sponge. It is proposed to either manufacture steel direct or manufacture a cast product which can afterward be utilized in the Siemens-Martin furnace. In a general way, it is understood in Sweden that Dr. De Laval's process consists in mixing pulverized iron ore with carbon, probably in the form of pulverized peat, and subjecting the same in some form of a rotating cylinder to heat, after which it is brought into direct contact with an electric arc of tremendous power, which reduces the ore to metallic iron. The melted iron then flows into a large and highly heated furnace, where it can either be manufactured directly into steel or cast in any suitable form for further treatment.

WATER FOR BOILERS.

BY M. W. DANIELSEN.

THERE never was a time when it was more necessary to look after the equipment of the mill or shop than the present, and we are glad to see that some manufacturers are putting their establishments in shape, so as to be able to meet the closest kind of competition. It would be difficult to define the exact advantage a good equipment has over a poor one—the ordinary expression, "covers a profit," does not fully describe it. But involved in the matter is a point which is sometimes overlooked, namely, good water to correspond with the efficient boiler equipment.

If one desires to locate a factory or central station, one of the most important factors, which should lead to the acceptance or abandonment of a certain locality, is the question of quantity and quality of the available water supply. The boilers will have to be supplied with suitable water, stock is to be cleansed by water, water may have to be used as a dissolving agent for chemicals, and there should be water fit to be used for miscellaneous purposes.

Some steam users usually consider that if pond water is used, there is less trouble likely to arise than if spring water is fed into the boilers. Pond or river water is almost sure to bring with it, at times, vegetable matter or other troublesome materials. It is well known that works that use spring water have more trouble with scale, than the boilers directly fed from ponds or brooks, for spring water has not the same chance to mix and dilute its scaling properties as water which flows some miles before used, and water which will make the clearest bleach, is sure in most cases to make a very hard scale.

The water which evaporates from the surface of the ocean and has again been precipitated as rain, under the influence of cold air currents mixing with the warm vapor-laden currents from the ocean, is practically free from dissolved inorganic impurities or salts. Yet in its descent through the air it absorbs all the impurities contained therein, soot, dust and organic matter and germs of all kinds; it is likewise rich in ammonia and nitrous acid. It purifies very easily in consequence, when it is kept in cisterns.

The inorganic substances mainly met with in waters are lime, magnesia, oxide of iron, potash and soda, in combination with sulphuric acid, phosphoric acid, hydrochloric acid, nitric acid, carbonic acid and silicic acid or silica. I have always found that rain water is the ideal boiler water and use it in my boilers. In order to keep a basin of such water in good condition, I rig up the system of pipes shown in the accompanying diagram, Fig. 1.

The pipe, B, is covered by a strainer, A, through which the water enters. The current flows upward through C, and downward through D, into a drain. To the pipe, C, is at-

tached an overflow outlet, E, which is adjusted so as to keep the water line a few inches above the level of the pipe, C. Thus there is a downward pressure into the submerged outlets, slightly in excess of the upward thrust which is necessary to effect an escape and serves to keep the water supply in good shape for the boilers, as the water is drawn from the lower part of the basin, and not wholly from the top as usual.

If the rain water passes through soil its composition changes

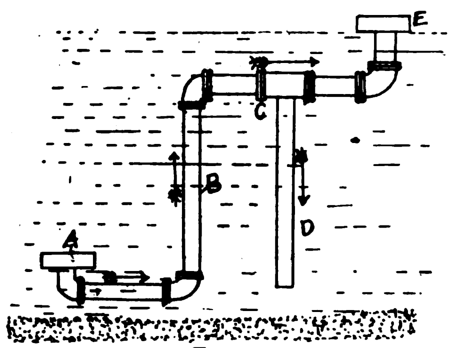


FIG. 1.

considerably, but the changes wrought differ with the composition of the soil. In the first place the soil acts like a filter and removes much of the natural impurities of the rain water, especially the undissolved portion, the soot, the germs and organic debris. Then, however, it may act chemically on the dissolved substances like nitrous acid and ammonia, and finally the soil yields certain substances to the water, which increase the dissolved impurities of mainly inorganic nature, but frequently also inorganic matters.

In passing through a soil derived from the disintegration of granite and gneissy rocks, the water takes but little inorganic material, and such a water remains therefore soft.

In passing through layers of old sand stones they are likewise soft; formations consisting alternately of younger sand stone and limestones, especially the latter, impart generally great hardness to water.

I have found it beneficial to run greasy water through an

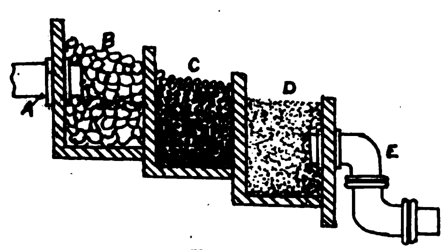


FIG. 2.

arrangement like that shown in Fig. 2, before feeding it to the boilers. Any carpenter can build the chambers, B, C, D, of wood, in the first of which should be put stones, in the second gravel, and third sand. The water should be filtered through this, entering the pipe, A, and going to the boilers through the pipe E.

LITERATURE.

WHAT IS ELECTRICITY? By Prof. John Trowbridge, S. D. New York: Appleton & Company. Illus. 12mo, illus. 315 pp. Cloth. Price, $1.50.

We don't know, and we never shall know, is the answer that Prof. Trowbridge gives to his own question; but the book is something more than a miserable and irritating confession of human ignorance. It sets forth in a series of naturally sequential chapters the outlines of knowledge in regard to electrical phenomena, and winds up by saying that: "We have already strong grounds for believing that we live in a medium which conveys to-and-fro or periodic movements to us from the sun, and that these movements are electro-magnetic, and that all the transformations of light and heat, and, indeed, the phenomena of life, are due to the electrical energy which comes to us across the vacuum which exists between us and the sun—a vacuum which is pervaded by the ether, and which is a fit medium for the transmission of the electro-magnetic waves." To have gone thus far is to have done a great deal, and Prof. Trowbridge's pages are full of the data upon which certainty is assured, no matter what may be the ultimate interpretation. Chapter 21 is particularly interesting in its comments upon the nature of the sun as the source of heat and therefore of all our forms of energy, including electricity, and as being itself nothing but an electric oven on a vast scale. Many of our readers will enjoy this book as a review in popular form of current physical science, and they have plenty of friends to whom they can offer it as a helpful exposition of the subject.

POOR'S MANUAL OF RAILROADS. New York: H. V. and H. W. Poor. Price, $7.50.

This, the twenty-ninth issue of the manual, is more valuable than ever. It presents the statistics of more than 4,000 companies, of which over 1,200 are in the street railway field. A remarkable feature is the inclusion of industrial securities, and State and municipal investments. The book is a mine of information.

"GODEY'S MAGAZINE" has begun a short series of articles on "Benjamin Franklin." It is a relief to know that his were the victories of peace, and that there will be no pictures of battle and bloodshed in which he will appear as the chief actor.

LETTERS TO THE EDITOR.

THOMSON WATT METERS IN CANADA.

I have read Mr. Haskins' defense of the Thomson wattmeter and would state that all electric meters in Canada are inspected and sealed by the Government and remain sealed for 6 years, when they are again tested.

This, you must admit, changes the matter considerably, and I am sure when Mr. Haskins makes some experiments with these meters which have been sealed up for any length of time, the results will not be so accurate as those obtained from the experiment he describes.

JAMES MILNE,
Toronto Elec. Lt. Co., Ltd.

September 20, 1896.

THE KINCAID STREET ARC LAMP REFLECTOR.

I notice in one of your London contemporaries a brief note on my street arc lamp reflector, described in the Electrical Engineer of August 5, 1896, which the editor criticizes on the score that "if the mirrors are accurately designed the result would be to give four narrow beams of light. The width of the beams would also be much more narrow than the roadway."

In answer to this I would say that if such were true there would certainly be reason for serious objections to the use of the reflectors. But, as experience proves, an accurate mirror of that description is a commercial impossibility. And again, the source of light, the crater and carbon tip is very far from being a mathematical point in size, producing altogether a beam more or less diverging.

I found, however, that with the foci and arc coinciding, the beam was rather too narrow, and widened it by slightly altering the focal points of the reflectors.

To widen the beam in the immediate vicinity of the lamp I found it advantageous to gradually depart from a true parabolic curve at each extremity of the reflectors. This had the desired effect without unnecessarily widening, and thereby diminishing the intensity of that part of the beam cast by the perfect curve of the middle portion of the reflector, and intended to light the most distant points. As the beams of light diverge from a comparatively narrow source, it must necessarily follow that in the immediate vicinity of the lamp there will be shadows, to light which I would use a convex, annular, translucent reflector placed directly under the side reflectors on an ordinary globe holder.

Of the direct rays of light incident upon this translucent reflector part will be reflected over the dark areas, and the remainder in passing through will be diffused over the roadway underneath.

There being "no strong local light," there can be no objection on that point. In driving toward the light the reflected light was no more severe on the eyes than that from the naked arc, as was proved by removing the reflectors. Only at distances exceeding 200 or 250 yards does the greater penetrating power of this light become apparent.

W. H. KINCAID.

Santa Barbara, Cal.

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CONTENTS.

OCEAN TELEPHONY.

AUTHORITIES in matters telephonic have so long and so often, and with good reason, pointed out the insuperable difficulties that stand in the way of telephony through submarine cables between Europe and America, that work in this field has up to the present time been monopolized almost exclusively by charlatans. When one considers the inexorable laws which govern the speed of transmission in cables, it does give one a sharp twinge of surprise to have the possibility of accomplishing the feat pointed out by a man whose work in the past entitles him to unquestioned respect, and whose utterances are not to be lightly brushed aside. Encouraged by the results reached with the channel cable, forming part of the telephone line connecting London and Paris, Mr. Preece, in his paper, read before the British Association, describes the results obtained with an improved type of cable, which lead him to the belief that at no distant day he will be able to hold telephonic communication between England and Germany over submarine cables 225 miles in length. Mr. Preece goes even so far as to hint at the possibility of transatlantic telephony with a type of cable identical with the old Edison halfmoon lighting conductors.

Perhaps the most marked feature in the construction of the proposed cable is the adoption of paper insulation immediately surrounding the conductor. We dare say that had such a proposition been made but five years ago it would have been ridiculed in England, yet we think America may, with justice, claim to have brought about the adoption of this method of insulating telephone cables, which has had a marked influence on the method of manufacture of telephone cables the world over. As one looks back scarcely a decade to the time when the specifications for telephone cables called for no lower electrostatic capacity than .2 microfarad per mile, and considers that to-day manufacturers are guaranteeing cables with close on to .07 microfarads, the great strides made and the possibilities which such a reduction in capacity opens up are apparent. Mr. Preece's plans may be looked upon as visionary, but we hope that he will carry them out and test them to the fullest extent. It has been argued in some quarters that nothing would be gained, in a practical way, by transmitting messages telephonically over the Atlantic cables, as the best types of such cables at the present time, working duplex, transmit with almost as great a speed as speech could be transmitted and recorded by telephone, having due regard for accuracy, which is here of special importance, since the larger part of cable work is done by code, in which one word bears no relation to the next. We are not among those who look upon the question in this light, however. As an

achievement alone, the work would be well worth undertaking, if it could be carried out at a reasonable cost, and we feel certain that once accomplished, a use would be found for transatlantic telephone cables, just as a use has been found for that magnificent network of long distance telephone lines, which have brought all of our cities east of the Mississippi within hailing distance of one another, notwithstanding the previously existing telegraph lines.

WORK FOR THE N. E. L. A.

THE National Electric Light Association exists because there is good reason for its existence. We doubt if any other such organization has, during the present year, given so many proofs of its usefulness to the industry represented or of desire to conserve and build up the constituent members and promote their prosperity. First and foremost, of course, among its achievements stands the electrical exhibition in this city, which has already made a deep impress on the electrical arts, and which has given decided stimulus to the central station industry by showing that all the improvements are not exhausted and that many new things remain to be done. This was a great work, but as if to show that it was not seeking mere spectacular glory, the association has turned at once to the directly practical and technical sides of the industry, and has suggested reforms that everybody must heartily welcome. The spirit and the attitude of the president of any association must count as a large and determining factor in work of this character, and it is only fair that the keen intelligence and profound knowledge of the conditions involved, brought to bear on the duties of his office by Mr. Frederic Nicholls, should be recognized and heartily commended.

We publish elsewhere in this issue the report, ad interim, the second of the kind presented by President Nicholls since his election only last May. We also give an account of the conference called by him on the subject of socket and lamp-base standardization. Here was a vital question "in the air" and waiting for somebody to grapple with it. Our own pages have been full of discussion of it, but a newspaper is a forum, not an executive body, and it required that the lamp manufacturers should themselves set the great work of uniformity and standardization on foot and push it to perfection. If Mr. Nicholls' incumbency of office bore no other mark of effort than this beginning of the great period of standardization in electric lighting details it would be honor and credit enough. But there are other things to be attended to, and we are satisfied that no good work will escape the association's vigilance and laudable ambition, with its present energetic executive.

STORAGE BATTERY LOCOMOTIVES.

WE have no doubt that many electrical engineers, on reading the illustrated account of the placing of a storage battery locomotive on the elevated railways in New York, which appeared in our last issue, shrugged their shoulders at the idea, and mentally classed this experiment with numerous preceding ones in electrical work as foredoomed to failure. We must confess that at first sight the proposition to operate storage battery locomotives in competition with the direct system of conductors seems somewhat difficult to carry out, but nevertheless the projectors of this exceedingly interesting trial feel convinced that they can demonstrate the feasibility of the system. On another page we print a discussion of the benefits claimed for this system, which merits the closest attention of those interested in electric railway work, whether for elevated or surface traffic. The cost of feeders on any extended system of railway, the management of which has due regard to the character of its service, becomes more and more onerous as traffic increases, while, on the other hand, the fluctuating nature of the power drawn from the central station is a matter of well known loss of efficiency at that point. To equip each motor car or locomotive, as the case may be, with an independent source of current, albeit small in capacity, unquestionably removes the objection which the present existing method of operation involves. It is true that a large proportion of the many troubles incident to electric railways could be avoided by the introduction of storage batteries at the central station itself, or distributed at suitable points on the line, but the ideal method, it must be admitted, is that proposed by those undertaking the present work on the elevated railroad in New York. It is, of course, still too early to look for a definite result regarding the experiment, but we consider the attempt a most important one, and one which should meet with all encouragement at the hands of the electrical railway fraternity.

BRAINY LITTLE JAPAN.

DURING the past few months this country has been favored with the visits of three or four highly intelligent Japanese engineers and technical experts, who have given special attention to American electrical development with the object of ascertaining how far their country can be placed in line with our own in the utilization of modern inventions and ideas. It now appears that one of the first moves resulting from the inquiry is the extension of the telephone system, upon which a sum over 12,800,000 yen is to be spent by the government in a term of seven years, or, say, $1,400,000 a year. The public is eager for telephonic service, and it is said that in Tokio alone there are now 2,000 subscribers and 2,000 applicants waiting for connection with the exchange. In many other cities similar conditions exist, while the long-distance service will in particular receive attention. Another point to which the commissioners visiting this country paid special attention was that of power transmission, the plan being to employ for lighting and railway work many of the fine waterpowers scattered about Japan. In all this the courage and progressive spirit of the Japanese is to be greatly admired, and their enterprise will bear fruit generously.

SOUND MONEY LITERATURE.

SOME excellent work in the diffusion of sound money literature is being done by Mr. Allen R. Foote, editor of "The American Exporter" of this city. He has long made a study of the financial problem and of the influence of national monetary legislation upon industry and commerce. We have before us now copies of letters sent by him to gas and electric lighting companies in important States, fifteen in all, and of another letter to street railway companies in the same regions. He points out the vital necessity of sound money to all such enterprises, and invites their co-operation in distributing literature on the subject. This literature has been carefully prepared and is of small cost, and we trust it will be largely used. The subject is one demanding public education, and Mr. Foote is doing a good work that should be liberally availed of and assisted right now.

TELEPHONY AND TELEGRAPHY.

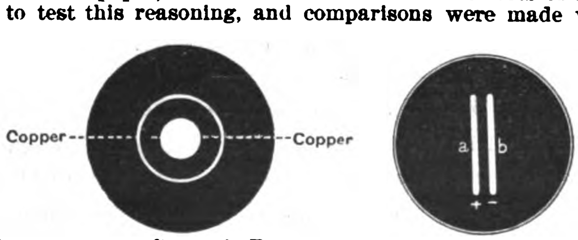
ELECTRICAL DISTURBANCES IN SUBMARINE CABLES.[1]

BY W. H. PREECE.

The author's paper was divided into two sections, the first treating of telegraph and the second of telephone cables. In the former he traced the changes which had been brought about in the speed of signaling in the Anglo-German cables, leading up to the latest type in which the cable, consisting of four stranded conductors, has each conductor core surrounded by a brass tape which entirely shields the conductor from electrostatic induction. The possible rate of working of the 1896 cable is 33 per cent. better than that of the 1891 cable.

In the section devoted to telephone cables the author stated that the total energy expended in any circuit in a given time may be considered under three heads: 1. That expended in overcoming resistance. 2. That expended in producing the electric field. 3. That expended in producing the magnetic field.

In each case we must consider the energy stored up and that dissipated. The former tends to retardation, the latter to work done, and therefore to reduction of efficiency. Careful regard must be paid to the directions in which the different disturbing forces act, for it may be that they oppose each other, and direct the energy into the original channel under modified and more favorable conditions. Thus, if the whole effect of the electrostatic field is neutralized by that of the electromagnetic one, the total energy developed is expended on the circuit itself, disturbances are eliminated, and the service improved. This is the case of a metallic circuit having a microphone transmitter at one end and a telephone receiver at the other. The capacity of such a system will tend to store up a portion of the energy of each current, but the electromagnetic induction between them will tend to supply the deficiency. If the two wires of the loop be far apart the influence of mutual induction will be much less than that of capacity. As they approach, the electromagnetic induction must increase at a greater rate than that of the electrostatic induction, until, finally, at the limit where they coincide, the one must exactly neutralize the other. This, perhaps, is better seen if we consider the case of a concentric cable; for, in this case, the number of lines of electric force does not increase, while the number of lines of magnetic force cutting the other conductors does increase rapidly as the outer conductor approaches the inner. The maximum induction from each source must take place when the two conductors are infinitely near each other, and this maximum must equal the primary current, for it cannot exceed it unless there were fresh creation of energy. Thus, as the separating dielectric becomes smaller and smaller, the two effects approach each other closer and closer, until, at absolute contact, they annul each other. The result must be that if these be the only conditions present, the time constant must diminish as the two conductors approach each other, and in the limit it must disappear. Twenty miles of concentric cable (Fig. 1), insulated with paper, were made and laid in the streets of London to test this reasoning, and comparisons were made with



FIGS. 1 AND 2.—PREECE'S EXPERIMENTAL TELEPHONE CABLE.

ordinary parallel cylindrical conductors, insulated both with gutta percha and with paper and air. The result was very encouraging; but an unsuspected difficulty arose from the want of symmetry of the capacity of each conductor and the earth. The insulation resistance of each conductor was also different, and the result was that when the concentric cable was joined to overground wires, serious disturbances were experienced in the working circuits, which, however, were remedied by crossing the conductors of the concentric cable at several points, so that each side of the circuit was sometimes the inner and sometimes the outer conductor. This, however, is a cure that could not easily be applied to a submarine cable. It is clear that in such a cable symmetry of capacity with earth and of insulation is essential.

The experiment with the concentric cable shows that we have to consider not only the capacity between the two conductors, but that between each conductor and earth. Symmetry can be produced if the conductors be shaped and arranged as in Fig. 2. Only a certain number of lines of electric force, dependent on the voltage present, can emanate from each conductor. The closer a and b (Fig. 2) are to each other, and the further they are from the earth, the greater the number of lines between the conductors and the fewer to the earth. The electric field is, in that case, confined almost entirely to the space between a and b.

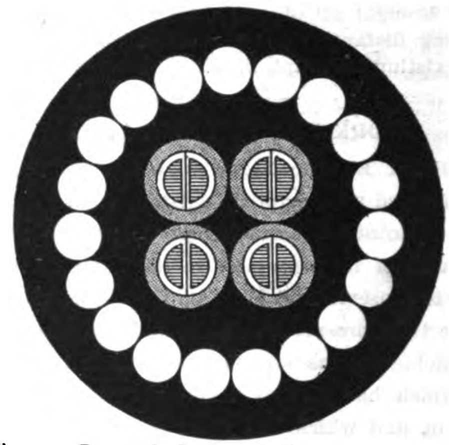


FIG. 3.—PREECE'S PROPOSED TELEPHONE CABLE.

The problem resolves itself into a practical question: What is the best form to give the cable with our existing experience and our available materials? My present solution is given in Fig. 3. The conductors are insulated first with paper and then with a thick coating of gutta percha. Paper only exists between the conductors. The cable is sheathed and compounded in the usual form. There are four circuits, instead of two, as at present in the London-Paris cable.

With such a cable I have little fear of speaking between England and Germany (about 225 miles); but to test the practical points that arise in the manufacture of such a cable it is proposed to make and lay a short one to the Isle of Wight. If my reasoning is correct, and so far experiment has confirmed it, then not only ought we to be able to speak to great distances, but the type of ocean cables must be revolutionized, for what is true for telephony must be equally true for telegraphy. Cables such as those across the Atlantic might, with the same weight of copper, be made to transmit a greater number of words per hour than they do now.

[1]Abstract of a Paper Read Before the British Assoc. at Liverpool.

SEEING BY ELECTRICITY.

BY ED. WAGEMAN.

THE results of my experiments with the problem of seeing at a distance by means of electrical appliances of different construction have been as follows:

First of all an instantaneous transmission I have not yet been able to obtain; the person or the scenery must be immovable at least for a minute in front of the transmitter, and the light strike right in front of the same. In the receiver appear white spots and shadows, grouping themselves into a sort of daguerreotype of a clear and distinct nature. If from any cause the positions in front of the transmitter are in the least changed, the outlines in the receiver become blurred, assuming new outlines only after a lapse of about one minute. In no instance was the least trace of a transmission of color observable. The line, having capacity, made the outlines at times unduly enlarged. The same effect resulted from an electrical disturbance in the vicinity of the wires and the apparatus.

I have come to the conclusion that the problem will not be successfully solved by the employment of only one wire. In my experiments three wires are employed, one wire each for the direct and the alternating current, while in the return wire the one current is superposed on the other. The employment of iron wire will very likely not be possible, and the employment of relays or electromagnets must be avoided as

much as possible or their construction altered to suit the conditions.

An ordinary 16 candle power Edison incandescent lamp gives by far better results than the Crookes tube with Röntgen rays. I am unable at present to perceive how to get the color transmitted and reproduced. Selenium pure and simple will not accomplish it; besides, the selenium film alone does not seem just exactly the proper medium to reproduce color.

In my opinion, the solution of the problem will necessitate the co-operation of the physicist, electrician and chemist, and of the latter, one who has made the study of the hydrocarbon group a specialty. It will not be accomplished by one man alone, and those investigators who have at their disposal the largest and best laboratories and money to back them up will get ultimately closest to the solution of the problem.

THE HISTORY OF THE HARRISON INTERNATIONAL TELEPHONE CO.

IN Chicago last week Judge Grosscup issued an injunction restraining the Harrison International Telepnone Company and the Harrison International Telephone Construction Company from disposing of any of the company's assets. The injunction was issued for J. A. Williams and D. J. Young, of Fort Smith, Ark., as complainants. The list of defendants is a long one, and includes many men prominent in national politics and finance.

In the bill of complaint it is stated that the Harrison International Telephone Company was incorporated under the laws of Illinois in December, 1892, with an authorized capital of $80,000,000, divided into 800,000 shares. This stock was to be non-assessable. Stock was subscribed by the following: Edward M. Harrison, $30,000,000; Charles M. Ferree, $20,000,000, and Albert L. Stone, $30,000,000. It was claimed at the time that E. M. Harrison owned certain patents which would give the company almost a clear field in the telephone business of the country.

After the stock was issued 500,000 shares were set aside as treasury stock, and the remaining 300,000 were to be divided among the three original subscribers. In order to place the company in such a position that its stock would sell easily, the following men were each given 20,000 shares of treasury stock, and their names used as directors and active managers of the company: Stephen B. Elkins, R. C. Kerens, George R. Peck, William Warner, Patrick Egan, Howard M. Holden and Charles Foster. The stock given to these men was entered in the company's books as donated. Stephen B. Elkins was elected president and Patrick Egan secretary.

It is asserted by the complaint that these men were fully aware of the fraudulent issue of stock, and that their names were to be used to give the company prestige in the eyes of investors. It is also stated that after their election this board of directors took active charge of the affairs of the company and were fully aware of the fraudulent transactions of the company.

From that time the sale of stock assumed enormous proportions. It was heralded that the Harrison Company would enter into active competition with the Bell Company. Buyers of stock were in many cases widows, small trust companies and others who had been led into the company because of the eminence and respectability of the board of directors.

In March, 1894, the telephone company virtually passed out of existence, as its directors transferred the right to sell, use and introduce its electrical appliances to the Harrison International Telephone Construction Company. The stock was reduced one-half, but to such straits had the company come that the stock did not appreciate. The directors of the old company, in order to relieve themselves of liability, transferred a controlling stock interest to L. E. Ingalls for a nominal sum.

The complainants owned stock in that branch of the general company known as the Arkansas Telephone Company, with a plant valued at $25,000. This stock, upon representations of stability, was transferred for that of the Harrison International. May 4, at the annual meeting, it was learned that the tangible assets of the Harrison International Company would not amount to more than $100,000, and that these were about to be transferred to the construction company. A receiver is accordingly asked for to wind up the affairs of the telephone company, and until such a receiver is appointed the complainants asked for an injunction to prevent the sale of tangible assets.

SAVANNAH, GA.—A new exchange is to be built at Savannah by the Southern Bell Telephone Company.

POWER TRANSMISSION.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.[1]—II.

BY DR. LOUIS DUNCAN.

CONTINUOUS CURRENT LOW VOLTAGE DISTRIBUTION.

SOME of the most important stations supplying incandescent lamps are operated on the three-wire continuous current system. In the last few years a considerable advance has been made in the sale of power for motors from these stations, and this has increased the revenue and has given better average output. The tendency in this country has been in the direction of using storage batteries in such stations, and abroad practically every continuous current station uses batteries. It would unquestionably be more economical, in many instances, to use single stations, to transmit power from these stations to centers of distribution, where batteries may be located and to distribute from these centers on a three-wire system. A case in point is the system used at Buda Pesth, where the energy is distributed from the central station to rotary transformers at sub-stations, these rotary transformers feeding batteries, current being distributed from these batteries on a three-wire system. The reports of the operation of this station show that it is both economical and successful, and it might well be copied by some of the companies in this country.

ALTERNATING CURRENTS FOR LIGHTING.

Alternating currents have been employed for lighting in this country, and they have been especially valuable where a district is to be supplied in which the distances are considerable as compared with the number of customers. It has been almost the universal custom to supply small transformers for each consumer, and while the average size of transformers is greater now than it was a few years ago, yet they are comparatively small. No power has been supplied from such stations, and although alternating arc lamps are used to a limited extent, yet the number is not increasing, and in some cases continuous current arc lamps have been substituted for the alternating. Under these conditions the load on the station is even more variable than in the case of a continuous current supply where motors may be employed, and the constant loss due to the large number of small transformers used, places this system at a disadvantage as compared with the continuous current system. Abroad in the last few years most of the new stations that have been built use continuous currents, although some years ago the greater proportion of them were alternating current stations. It is also the custom abroad to use sub-stations with large transformers for distribution, thus doing away with a considerable part of the constant loss due to the small transformers used here. It is not possible, at this present time, without greatly complicating the system, to obtain a steady load on the station, and the only question that arises is the value of sub-stations, and the possibility of using some form of alternating current other than the single-phase.

METHODS OF ELECTRICAL TRANSMISSION.

Coming to the question of transmission of electrical energy as distinguished from the supply to customers from distributing centers, there have been great advances made in the last few years, and these mainly through the introduction of multiphase alternating currents. Single-phase alternating currents permit the transmission of power to long distances and its distribution for lighting purposes. It is also possible to supply power from such circuits to large motors working under a steady load. It is not possible, however, to distribute power economically for ordinary uses. The introduction of multiphase alternating systems, where two or more alternating currents are employed, the currents differing in phase, has completely changed the situation with respect to long distance transmission. I shall consider briefly the possibilities of such systems and their value as compared with any direct current system.

CONTINUOUS CURRENT TRANSMISSION.

The first long distance transmission plant was operated by the continuous current system, and even now plants are being built in which continuous current of high potential is used to transmit energy to distances up to 15 miles. If we consider the relative cost of the copper in the line for a given amount of power transmitted and for a given maximum potential be-

[1] Presidential inaugural address read before the American Institute of Electrical Engineers, Sept. 23, 1896.—Abstract.

tween the conductors, we will find that the relative amounts for the continuous current and the different alternating current systems, will be as follows:

Continuous Current	100
Single-phase Alternating	200
Two-phase "	200
Three-phase "	150

We see then that the continuous current has a marked advantage over the alternating current systems as far as the cost of copper is concerned. There are, however, certain practical disadvantages belonging to this system. The high voltages necessary for long distance transmission make it impossible to distribute the current at the receiving end without first reducing the voltage. With continuous current this can only be done by employing a rotary commutator of some kind. A plan which has been practically and successfully used has been to run a number of dynamos in series at the generating end of a line, while at the receiving end are a number of motors, also arranged in series, which are used to drive other generators to give the required type of current and the desired voltage. It has not been found possible to make either dynamos or motors of any great output, as there are practical difficulties in running dynamos of high potential where the current taken from them has a considerable value. M. Thury, has installed a number of continuous current transmission plants that have apparently given excellent results. At Biberist, a transmission of 15 miles is employed. At Brescia, 700 horse-power are transmitted over 12 miles at a maximum of 15,000 volts. M. Thury states that generators for 45 amperes can be constructed up to 3,000 volts, and he thinks that 4,000 could be successfully used. These machines, however, are small when compared with the 5,000 horse-power dynamos in use at Niagara, for instance, and where the transmission is a large one the great number of machines necessary would be a serious objection to this type of transmission. It will be seen that the greatest possibility of trouble, in such a transmission, lies at the ends of the line, in the generating and receiving apparatus. It must be recognized, however, that this system has been successfully used and has given excellent results in a few cases of transmission. Its great advantage lies in the decreased amount of copper as compared with the alternating systems, and in the absence of induction effects, which are a drawback to alternating current transmission.

TRANSMISSION BY ALTERNATING CURRENTS.

A large proportion of the transmission plants that have been installed in the last few years have been of the alternating current type. These have, as a rule, given satisfactory results, and the installations that are now being erected or planned are almost exclusively on an alternating current basis. The great advantage of this system lies in the fact that it is possible to change the voltage of the current without the use of rotating apparatus, and at once economically and safely. If we compare this method with the continuous current system, we will see that to obtain an alternating current of the required pressure at the receiving end of the line, we would use the same number of transformations required by the continuous current system. We have the great advantage, however, that our changes in voltage have been obtained by the agency of stationary apparatus, which is much cheaper, is more efficient and is safer than that required in the continuous current system. It is possible to increase the voltage by means of transformers to almost any value with perfect safety and with an efficiency as high as 98 per cent. or 99 per cent. If then our alternating current, when it has been reduced at the receiving end, is as valuable for distribution as the current obtained by the direct current system, there will be no doubt that alternating transmission has great advantages over continuous currents.

There is no single-phase motor in successful commercial operation that does not require to be started from rest by some outside means. This prevents a single-phase current from being used at the present time for power distribution; and as, in most transmission, the distribution of power is an important item, single-phase currents are not suitable for this purpose. In a two-phase system the currents are usually carried on separate pairs of wires, while in the three-phase system, three wires are generally used, a common return being unnecessary as the sum of currents is zero, unless the circuits are unbalanced. In distributing on the three-phase system, a fourth wire can be employed, as it gives an advantage in the amount of copper used.

In all these alternating systems the great difficulty lies in the fact that the inductance of the circuit causes the current to lag behind the electromotive force. In the case of transmission to very long distances the line inductance is a large proportion of the total, while the inductance of the receiving apparatus depends upon whether lights or motors are to be supplied and upon the construction of the latter. The difficulty due to the uneven loading of the circuits is specially marked in the case of the three-phase system, and it is one of the principal objections that have been urged against the employment of this system for distribution. It should be pointed out, too, that it is not enough to balance the quantities of current for the three-branches of the system, but the character of the current must also be considered.

As for line inductance in the two-phase and three-phase systems, there is no question that the latter has an advantage in this respect. By suitable arrangement of circuits the line inductance can be brought to a minimum, and this is of the utmost importance in long distance transmission. I will not take into account the supposed increased efficiency of three phase motors and dynamos as against two-phase apparatus, as there is a question as to whether a superiority exists, but simply considering the decreased amount of copper required and the decreased inductance of the line, there is no question, in my mind, that for transmission, the three-phase system is superior to the two-phase. It is well known, of course, that the inductance of the circuit can be, in some measure, compensated for by the use of condensers or over-excited synchronous motors. The first of these remedies is, however, a very uncertain quantity commercially, while the second should be used as much as possible, that is, as many synchronous motors should be connected as is practicable. The best remedy, as things stand at present, lies in the careful construction of the line and the apparatus, so that the effects, although they exist, can be reduced to a minimum.

It has been shown by Mr. Scott, and others, that it is possible to transform a two-phase into a three-phase current, to transmit it and to transform it back again to a two-phase current. This will allow us, if we wish, to use two-phase dynamos for generating the current, to transmit with the advantage incidental to the use of three-phases, and at our reducing end to use two-phase circuits for transmission. This has some advantages as far as balancing the voltage on the circuit goes, and it has been proposed in the case of several plants whose installation is being considered.

Looking broadly at the value of alternating transmission as against continuous current transmission, we have a gain in the simplicity and safety in the transmission, and at the distributing end the use of multiphase currents enables us to supply both lamps and power with an economy and success comparable to that of the continuous current system. If it is necessary to use continuous currents for certain types of distribution at the receiving end, they can be obtained by the use of rotary transformers, by which the alternating current is transformed into a continuous current. These machines have approximately the efficiency of corresponding continuous current dynamos, while the output for a given size is about 50 per cent. greater.

MARRIED.

MEIKLEHAM—DASH.—The marriage took place on October 7 of Mr. T. D. R. Meikleham, of C. C. Sibley & Co., to Miss A. D. Dash, at the Church of the Mediator, Kingsbridge. New York City. The officiating clergyman was Dr. Morgan Dix, assisted by the Rev. Dr. McKee Brown and the Rev. George Nattress. Mr. W. A. Meikleham was his brother's best man.

STEERS—BEALES.—On Wednesday, October 7, 1896, at Clover Nook, Scarsdale, N. Y., Mr. James Rich Steers was married to Miss Mary Dolores Beales, daughter of Mrs. James A. G. Beales, and grand-daughter of the late Eugene Kelly. Owing to the illness of Mrs. Beales, the wedding ceremony was held at the home of the bride in a quiet manner, none but members of the family being present. Although a large number of friends and acquaintances had originally been invited, the cards were recalled some days ago. Mr. Steers has been connected with the electrical business for some years, starting with the Interior Conduit and Insulation Company, and now being the partner of Mr. A. K. Warren, trading under the name of A. K. Warren & Co. Mr. Steers has also the distinction of being a nephew of James Steers, the builder of the racing yacht America. He is a graduate of Columbia College.

OBITUARY.

HIPPOLYTE LOUIS FIZEAU.

The death is announced at the age of seventy-seven, of Fizeau, who devised the first method for the determination of the velocity of light by means of the revolution of a toothed wheel, placed between the observer and a distant reflecting mirror. Fizeau also made researches on the velocity of propagation of electricity. He was a member of the French Academy of Sciences, and made many contributions to the "Comptes Rendus" of that body.

SOCIETY AND CLUB NOTES.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—PRESIDENT'S INTERIM RERORT NO. 2.

PRESIDENT Nicholls, of the National Electric Light Association, has just issued his second ad interim report, which is printed below:

I have to advise you that, since issuing my first interim report in August last, the officers and Executive Committee of the association have been actively engaged in endeavoring to promote the interests of the association and its members. There have been many services performed for individual members, which, being more or less of a private nature, are not set forth herein; this report dealing more directly with the public policy of the association and such other matters as may be of value to the electric lighting interests in general.

INCREASED MEMBERSHIP.—I am pleased to report that a number of new members have been added to the roll of the association within the past few weeks, and that the prospects are that, before our next convention, we will have a larger active membership than at any time previous; and our secretary, who has just returned from a visit to a number of central stations, reports that an active interest is being taken in the work of the associaion.

MUNICIPAL LIGHTING STATISTICS.—In August last we issued to members for confidential use, a preliminary report of the cost of arc lighting in the cities and towns of the United States, and promised a supplementary report at an early date. This supplementary report has been incorporated with the preliminary one, and the bulletin containing these statistics has been compiled with an end to handy reference, and is most complete. A copy is herewith inclosed.

REPORT OF COMMITTEE ON DATA.—The most important standing committee of the association has been the Committee on Data, and it has been a matter of regret that the self-sacrificing efforts of its able chairman, Mr. H. M. Swetland, have not heretofore met with the support to which they were entitled. The information for the guidance of the committee was sought to be obtained in the past by correspondence and the filling out of blank forms, but always with discouraging results.

This year, with the approval of the Executive Committee, a different course has been adopted. Mr. Swetland and myself have had several conferences regarding the matter and scope of the report for our next convention, and a practical engineer of high standing was retained to personally visit a number of central stations in the East and West, and gather from first hands the information we had decided upon as being necessary. I have this week carefully reviewed such portions of the report as have been completed, and can promise our members that it will, in my opinion, when completed, be the most valuable publication yet issued by the association. It will be printed in book form, and will, I hope, be ready for distribution on or about March 1, next, so that members may have ample time to prepare for its discussion at the convention.

CONSOLIDATION OF LIGHTING AND RAILWAY INTERESTS.—Whilst admitting that there is plenty of room for widely divergent views as to the benefit, or otherwise, to those interested in a consolidation of the National Electric Light Association and the American Street Railway Association, I considered that the present was an opportune time for the discussion of the subject, and wrote Mr. H. M. Littell, president of the latter association, suggesting a conference. A letter, of which the following is a copy, has been received from the secretary:

"Frederic Nicholls, Esq., President,
National Electric Light Association,
Toronto, Ont."

"Dear Sir: The following is an extract from the minutes of a special meeting of the Executive Committee of the American Street Railway Association, held in New York City, September 9 and 10, 1896.

"'A letter from Mr. Frederic Nicholls, of Toronto. Ont., president of the National Electric Light Association, relating to the matter of the consolidation of the two associations, was read; and the secretary was instructed to notify Mr. Nicholls that the Executive Committee would be willing to have Mr. Nicholls appoint three representatives of the National Electric Light Association, engaged exclusively in the lighting business, to confer with three representatives of the American Street Railway Association, engaged exclusively in the street railway business; and that those gentlemen consider the subject fully'"

"Yours truly,
(Signed) "T. C. PENNINGTON,
"Secretary and Treasurer."

I have appointed the following active members of our association, Mr. W. S. Barstow, Brooklyn, N. Y.; Mr. Henry Clay, Philadelphia, Pa.; Mr. Chas. E. Scott, Bristol, Pa., to confer with the three gentlemen to be appointed by the American Street Railway Association.

A LEGAL OPINION REGARDING THE RIGHTS OF LIGHTING COMPANIES TO USE OF STREETS FOR OVERHEAD WIRES.—The following request for information was recently published in a New York electrical journal:

"We are having trouble with house-movers cutting our wires, claiming that they have a right to the highway. Our attorney here does not find any law bearing directly on this trouble, and we wish to make them stop bothering us if the law is with us. Please cite us to where we will find cases of this kind decided; and any other information relating to same will be thankfully received.

"Yours respectfully,
"McPherson Water and Electric Company,
"J. E. WRIGHT, Manager.
"McPherson, Kas., September 15, 1896."

The correspondent was referred by the editor to the secretary of the National Electric Light Association as being the most likely source from which to procure the information desired. Although this is one of those questions usually considered private, and the information sent direct to the inquiring member, I have thought that an opinion on the rights of central station companies to the use of the streets for the purpose of stringing wires would be of interest to our members generally, and therefore submit herewith an opinion from Mr. Eugene H. Lewis, of the law firm of Messrs. Eaton & Lewis, of this city:

"Frederic Nicholls, Esq.,
"Toronto, Canada.

"Dear Sir: You have requested my opinion as to the rights of owners of electric light wires strung along the streets of a city as related to the rights of the owenrs of buildings to move them along the highway and to cut all wires interfering with their progress.

It is difficult to give a satisfactory answer to a question of this character that would be applicable to both cases, as different States have different rules of public policy, and in different States the statutes, municipal charters and grants differ so widely as to render each case independent of others and determinable only upon the facts specially pertaining to it.

My opinion in general is that the moving of a building along a highway is not one of the rights enjoyable by the general public in a public highway for the purpose of travel, and that if a person moves a building along or across a highway, he must do it with due regard to the rights of property enjoyed by those who are then using the highway for purposes of transmitting electricity for power or illumination. You will hardly expect me to give my reasons in detail for this view, and I will not do more within the limits of this letter than to refer you to a few cases which have come under my observation bearing upon this subject.

"New York & New Jersey Telephone Company vs. Dexheimer." (14, N. J. Law Journ., 295.)

"In that case telephone wires were stretched across the highway in pursuance of the act under which the company was incorporated and with the consent of the municipal authorities. There was a proviso in the charter that the wires should be so located as to in no way interfere with the safety or convenience of persons traveling on or over the roads or highways. There was a statute declaring that the use of a public street "in any of the incorporated cities or towns of this State, shall be subject to such regulations and restrictions as may be imposed by the corporate authorities of said cities or towns." The city of Orange had adopted an ordinance declaring that "all telegraphic and telephone wires shall be placed so as to hang not less than twenty feet above the street crossing." The defendant had a special license to move a house along a street, and in moving it he cut all the overhanging wires, and in an action by the telephone company it was insisted on the part of the plaintiff that thirty of these wires were more than twenty feet above the street. Judge Depue, of the New Jersey Supreme Court, charged the jury that the use of a public highway in moving a building was not within the right enjoyable by the public in a public highway for the purpose of travel, and that the defendant's act was not justified on the ground that he was obstructed in the use of the highway for public travel. He held, however, that since the defendant had a special license to move the house, the defendant was justified

in cutting such wires as were maintained in violation of the city ordinance less than twenty feet above the surface, and he left it to the jury to decide whether any of the wires that were cut were more than twenty feet above the roadway, and to assess damages for the cutting of these, and these alone.

"The case of 'Williams vs. Citizens' Street Railway Company' (8, St. Ry. Jour., 102) arose in the State of Indiana, and was decided by the Indiana Supreme Court in December, 1891.

"In that case it appears that a church congregation, with the tacit permission of the city council, sought to move its edifice across a street occupied by a line of street railway, operated by electricity, with the overhead wire system. The building being too high to pass under the wires, the contractor employed by the congregation threatened to cut the wires, relying upon the tacit permission of the city and upon the claim that the company had forfeited its right in the streets by changing its motive power without specific authority. In a suit by the company, to enjoin the threatened destruction of its property, the point was made by the defendants that the court had no jurisdiction to control the city council in the exercise of its authority over the streets. The court, very promptly and properly, decided that the authority to determine legal controversies concerning personal or property rights had not been vested in the common councils of the cities of that State; that the failure or refusal of the common council to take steps to prevent the injury or destruction of the railway property did not preclude the company from seeking redress in court; that no individual could insist that the corporate existence of the company had terminated, or that he could, at pleasure, confiscate or destroy its property in order to move a house across its tracks; and that, although citizens had the right to the ordinary use of the streets, they could not interrupt traffic or discommode the public by tearing down street car lines in order to remove buildings along the streets.

"In your own city of Toronto, there arose the case of 'Toronto Street Railway vs. Dollery' (112, Ont. App., 679), in which it was held that a person cannot lawfully blockade the tracks of a railway company by moving a building.

"It is true that as far back as 1852, in the case of 'Telegraph Company vs. Wilt' (11, Am. Law Journ., 374), it was held that legislative authority and municipal license to set up a telegraph line in the street, were no defense in an action for injury to a house being moved along the street and caught by the wires. But that case does not seem to have been well considered, nor has it been generally followed by the courts, and it is expressly disapproved by Scott & Jarnagin in their works on telegraphs, section 53.

"I have not had time since receiving your request to search the decisions of the past three years relating to this subject, but, in my opinion, the foregoing cases in New Jersey and Indiana are much more likely to be followed than the case last referred to.

"I hope that the views expressed in these few lines will avail you for your purpose.

"Yours truly,

(Signed) "EUGENE H. LEWIS."

STANDARDIZATION OF INCANDESCENT LAMP SOCKET AND BASE.—The question of a standard incandescent lamp socket and lamp base has frequently been discussed in an informal way at meetings of the association, but no effort made to bring together those most directly interested.

Believing that much might be accomplished by holding a meeting under neutral auspices, I wrote to the manufacturers of sockets and lamps, inquiring if they would be willing to attend a meeting to discuss ways and means of endeavoring to solve this difficult problem, if such were called by the association. The replies received were unanimous in their expressed desire to be present at a meeting to be called by the association for such a purpose, and I therefore, on the 24th ult., issued the following notice of meeting. (Here follows the notice.)

Whilst I am doubtful of any direct result towards the desired end from this first meeting, I am hopeful that we can enter the thin end of the wedge at least, and by sustained and persistent effort accomplish what we have in view.

In conclusion, I have to request that members will promptly communicate with our secretary on any subject that properly pertains to the business of the association, and regarding which they may desire information or action.

THE AMERICAN INSTITUTE FAIR.

The American Institute Fair, which is in progress at the Madison Square Garden, New York, brings again the favorite exhibition with all its vigor and variety of exhibits which the Institute may well be proud of. With working machinery on the main floor and machinery downstairs and a splendid exhibit of flowers, fruits and vegetables in the concert hall there is so much for 25 cents' admission that no one can be disappointed who visits the Madison Square Garden. The music every afternoon and evening is a prominent feature, and, taken all in all, there is something for everybody to see and much for everybody to enjoy. The display in the concert hall will be kept complete until October 24, under the administration of the Committee on Agriculture and Horticulture and the Farmers' Club.

STANDARDIZING INCANDESCENT LAMP SOCKETS AND BASES.—MEETING OF MANUFACTURERS.

PURSUANT to a call of President Frederic Nicholls, of the National Electric Light Association, a representative body of incandescent lamp manufacturers met at the rooms of the American Institute of Electrical Engineers on October 9 for the purpose of devising ways and means to bring about the adoption of a standard socket and lamp base.

Mr. Nicholls, in opening the meeting, spoke as follows:

"In order that there may be no misunderstanding in regard to the attitude of the National Electric Light Association, I take the opportunity of stating before the business of the meeting commences that on behalf of the association I have endeavored to bring together the several interests here represented for the purpose of discussing the question at issue, and of trying to solve the somewhat difficult problem of standardizing the incandescent lamp socket and lamp base. This association is absolutely impartial, and it was thought that more could be accomplished by holding such a meeting under neutral auspices than in any other way. The object of the association in bringing together such a representative gathering now having been attained, it becomes your duty to elect a chairman."

On motion, Mr. Nicholls was requested to act as chairman, and Mr. Geo. F. Porter as secretary.

Mr. F. S. Terry then moved the following resolution; seconded by Mr. Hills.

"That it is the opinion of those present at this meeting that a standard lamp socket and lamp base is desirable." This was carried.

A long general discussion then ensued, nearly every gentleman present taking part, and many facts of interest were brought out, and seeming difficulties were debated as they arose.

The final results of the meeting are set forth in the following resolutions, which in each case were carried unanimously, it being understood that another general meeting is to be called to receive the report of the committee appointed.

Resolution moved by Mr. Ries, seconded by Mr. Rockwell:

"That before proceeding to investigate the patent situation or licensee question, to obtain the opinion of this meeting as to whether any existing type of socket or lamp base fulfills all the requirements that a standard socket should possess."

Resolution moved by Mr. Terry, seconded by Mr. Bryant:

"That the most desirable lamp base and socket, in itself considered, is a socket adapted for Edison base lamps."

"Resolved, That a committee composed of Mr. Terry, Mr. Rockwell, Mr. Bryant and Mr. Hills, be appointed to confer with the licensers and licensees of the socket patents with a view to arranging for their general use, and to report back to a meeting at an early date, and that the president of the National Electric Light Association be requested to act as chairman."

Among those present were the following: Frederic Nicholls, President National Electric Light Association; Geo. F. Porter, secretary, N. E. L. A.; Chas. I. Hills, Perkins Electric Switch Manufacturing Company; W. C. Bryant, Bryant Electric Company; C. E. Scott, Bristol Electric Light Company, Bristol, Pa.; A. A. Pope, Edison Electric Illuminating Company, New York; A. D. Page, Harrison Lamp Works, Harrison, N. J.; M. K. Eyre, General Electric Company; F. W. Hawkins, Electrical Engineering and Supply Company; A. B. Field, Anchor Electric Company; C. H. Rockwell, Buckeye Electric Company; F. S. Terry, Sunbeam Incandescent Lamp Company; C. D. Marsh, Bryan-Marsh Company; A. P. Seymour, Pass & Seymour, S. Wheelwright, John E. Criggal, Newark, N. J.; H. C. Wirt, General Electric Company; E. E. Ries, New York; W. F. Hanks, "The Electrical Engineer"; C. W. Price, "Electrical Review"; W. J. Johnston, and J. B. Taltavall, "Electrical World."

NEW YORK ELECTRICAL SOCIETY.

The society is to hold its first meeting for the season, on October 13, at 8 p. m., at Columbia University, Madison avenue and Forty-ninth street, when President Emery delivers an inaugural address entitled: "Reminiscences of Forty Years of Engineering Experience." Dr. Emery has rich resources to draw upon, and we have no doubt that his address which will have been delivered by this time will charm and instruct a large gathering of the members.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The next meeting of the Institute will be held at 12 West Thirty-first street on Wednesday evening, October 21, and will be devoted to a topical discussion on the subject of "Electric Traction Under Steam Railway Conditions." The discussion will be opened by Dr. Charles E. Emery, and prominent steam engineers as well as electrical engineers have accepted invitations to participate. Arrangements are being made for a similar meeting to be held at Chicago the same evening.

THE SPECIAL TRAIN from New York for the street railway convention at St. Louis, is to leave on Saturday instead ot Sunday, owing to the desire of many to be in St. Louis throughout Monday preparing their exhibits, etc.

DR. MARGARET A. CLEAVES, director, has issued an interesting report on the work for the year at the New York Electro-Therapeutic Clinic, Laboratory and Dispensary.

VEREINIGTE ELECTRICITAETS ACTIENGESELLSCHAFT OF VIENNA.

The firm of B. Egger & Company, of Vienna and Budapest, has been incorporated into a stock company with the above title. This is one of the oldest electrical firms in Austria and among the first to take up electric lighting and power work. Mr. Ernst Egger, who spent several years in this country studying American methods of manufacture, is chief engineer of the company. Both he and the company have our best wishes for their future.

EDUCATIONAL.

Y. M. C. A. STEAM ENGINEERING CLASS.

The steam engineering class of the Young Men's Institute, 222-224 Bowery, this city, opened its 1896-97 session on the evening of October 7, and will continue open Wednesday and Friday evenings of each week until April 29, 1897. The class is in charge of Mr. William H. Weightman, as usual.

Its object is the instruction of all employed or expecting to be employed in the practical operation of engines, boilers and machinery, and desirous of gaining a knowledge of or improving themselves in the theoretical branches, rules and practice of steam engine, boiler and power transmission calculations. Those desirous of availing themselves of the opportunity should join at once.

NEWS AND NOTES.

THE CHICAGO GREAT SOUND MONEY PARADE.

THAT the great parade which took place in Chicago on Friday, the 9th instant, was a truly magnificent pageant, goes without saying. All the trades in the city turned out in their strength determined to do their utmost to show that the great majority of their representatives thoroughly believed in the sound money standard, and were averse to any blind experimenting. Amongst the representative trades which took part in this splendid display the electrical industries had a most prominent place. Several meetings were held, having been originally called by Messrs. B. E. Sunny, C. E. Gregory and J. F. Gilchrist. A branch association was also established with F. E. Drake, president; C. T. Gage, secretary, and B. E. Sunny, treasurer. There were also other committees appointed, the principal one having representative men of every branch of the electrical industry to take charge of some particular duties, and be able to show what could be done by those engaged in this great industry on such an occasion. The electrical division, which mustered some 1,500 strong, formed at Haymarket Square, and joined with the steel and ironworkers, who composed the principal part of the second division.

Mr. F. B. Badt, who was appointed marshal, was unfortunately prevented from filling that office through sickness, and his place was taken by Mr. H. F. J. Porter. The electrical division was headed by one of the American Electrical Vehicle Co.'s electric carriages, and also by a banner, on which was inscribed, "Youngest industry in the line," "One thousand millions represented." Then came the squadrons of the various electrical industries of the city, including the Western Electric Co., 350 men, with banner, badges and gold canes; telegraphers, 350 men; Chicago Edison Co., 350 men, band, banner, gold badges, gold hats, gold umbrellas and white gloves; Chicago Telephone Co., 200 men; General Electric Co., 60 men, torch sticks, with incandescent lamp head, and decorated with bows of national colors, also banners with appropriate electrical terms, as applied to the present campaign; Electric Appliance Co., 35 men, full uniform, gold derby hats, gold capes, gold shoes, dark trousers, with gold stripe, and also an effective equipment of electrical apparatus. This company was drilled and officered under United States tactics, with drum corps. Central Electric Co., 32 men, gold sticks and several banners adorned with incandescent lamps and colored bows, and amusing inscriptions, which were apropos to the occasion, such as "The cat came back, and so will prosperity;" "Central Electric Co. for sound money;" "100 cents make a dollar," "Okonite, it never disappoints," and others. The remaining part of the electrical division, consisting of about 190 men, included electrical engineers, electrical contractors, and some who had had no special places assigned to them.

Another most important feature of the electrical division of the parade was the connection by long-distance telephone of several cities, East and West, with Chicago. Two large banners were placed at the Telephone Building and Great Northern Hotel, on which was the sentiment, "Your cheers at this point will resound throughout the union." At the former place were several large transmitters to convey the shouts of applause to the distant listeners, and there were also additional transmitters at the Great Northern Hotel and other points along the line of march. These cheers were heard in New York and other cities and by the Republican candidates.

MORSE RELAY SIGNALING BY MEANS OF HERTZIAN WAVES.

At the recent meeting of the British Association, Mr. W. H. Preece stated in the course of the discussion on Prof. Chunder Bose's paper on "Electric Wave Apparatus," that a young Italian, Signor Marconi, had described experiments in which he had, by means of Hertzian waves, transmitted signals over a considerable distance, and as a result Mr. Preece had assisted Signor Marconi to continue his experiments in London and on Salisbury Plain. Signor Marconi has now succeeded in producing electric waves and reflecting them from one parabolic mirror to another one and a-quarter mile distant, the waves falling on a receiving apparatus, which actuated a relay and produced Morse signals; the experiments have been made with crude apparatus and without employing any great amount of radiant energy.

MOISSAN'S EXPERIMENTS WITH THE ELECTRIC FURNACE.

In the current number of the "Annales de Chim. et de Phys.," M. Moissan, says "Nature," gives an interesting account of the experiments on the volatilization of refractory substances in the electric furnace. The sublimates were condensed on the outside of a curved copper tube placed two centimetres below the arc, and just above the substance under examination. A rapid current of water was passed through the tube, and kept it cool during the experiments, which usually lasted for about five minutes. The volatilized metals were copper, silver, platinum, aluminum, tin, gold, manganese, iron and uranium. Quantitative experiments were not made in every case, but it appeared that manganese was sublimed more rapidly than the others, and that the rate of volatilization of copper was about five times as rapid as that of gold. The condensed metal was usually, in great part, in the form of little spheres. Silicon and carbon were also volatilized and condensed on the tube, though the amount collected of the last named element was very small, and lime, magnesia, zirconia, and silica were sublimed without difficulty. M. Moissan draws the conclusion that the most stable compounds hitherto known disappear in the electric furnace, being either decomposed or volatilized. Nothing resists these high temperatures except the series of perfectly crystallized compounds discovered by him, and consisting of borides, silicides and, above all, carbides of the metals. M. Moissan intends to publish a description of these compounds shortly. He regards them as being probably among the original constituents of the globe, and as still existing in some of the stars.

PROF. ROENTGEN has received a copy of the Thompson & Anthony book on X-rays, and writes that he has read it with great interest.

"I do not want to miss a single number of The Engineer. Each number is a treat and is thoroughly appreciated."—B. Quinn.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Electro-Chemistry:

AN ELECTRIC FURNACE FOR IRON AND STEEL.—By R. Urbanitzky. A furnace suitable for preparing pure iron, which must subsequently be carbonized, is described in "Zeitschr. für Elektrochemie," vol. ii, p. 350.

Measurements:

TESLA'S ELECTRICAL CONDENSER.—Description of this instrument, for which patent was issued Sept. 15, 1896.—"Elec. Rev.," Sept. 23, 1896.

Miscellaneous:

ELECTRIC FARMING.—A few results obtained at the Agricultural Department of Cornell University and by Mr. Rawson, a farmer near Boston, are recorded in "Scientific American," Sept. 26, 1896.

FORT WAYNE ELECTRIC CORPORATION.—An extended, well illustrated description of the electrical apparatus of this company.—"Elec. World," Oct. 3, 1896.

Power Transmission:

GAS VERSUS ELECTRICITY IN POWER TRANSMISSION.—By Nelson W. Perry. Author compares the transmission of electricity with other methods, namely with water, coal and gas. The latter he finds to be an exceedingly economical method.—"Engineering Magazine," Oct., 1896.

ELECTRICAL ENERGY AT TOULOUSE.—A water power plant. Each turbine controls two dynamos which are run together to give the three-wire distribution. The tariff of charges is as follows:

Lamp of 10 candle power per month	....	$.70
" 16 " "	....	1.10
" 20 " "	....	1.30
" 30 " "	....	1.80

For arc lamps of four amperes or above one dollar per ampere per month is charged. For motors $1.20 per horse-power per annum is charged for 10 hours a day.—"Western Elec.," Sept. 26, '96.

TESTS OF POWER ABSORBED BY ELECTRICALLY DRIVEN MACHINE TOOLS.—By C. W. Pike. These tests were made at the Baldwin Locomotive Works and include the following: Three-spindle drilling machine, two-spindle drilling machine, radial drilling machine, several planers, slotting machine, double head locomotive frame slotting machine and shaping machine.—"Am. Machinist," Sept. 24, '96.

Railways:

WILLOW GROVE PARK AND ELECTRIC ROAD.—By Hermann S. Hering. A description of this pleasure park and of the road leading to it. Several maps, charts and tables. The article is begun in "Elec. World," Oct. 3, 1896, and is to be continued in subsequent issues.

LONG DISTANCE AND HEAVY DUTY ELECTRIC RAILWAYS.—By F. W. Darlington. Paper read before the Penn. Str. R'way Assoc., Altoona, Pa., Sept. 2, 1896. Author points out the many advantages of the electric systems, believes in the value of the direct current. He also discusses the questions of grading, curves, trucks, etc.—"Elec. Engr.", Sept. 9, 1896.

INSPECTION AND CARE OF CAR EQUIPMENTS.—By J. B. Cahoon. Paper read before the Str. R'way Convention at Binghamton, Sept. 8, '96. Speaker suggested the desirability of trip inspections, daily and monthly inspections.—"Elec. Engr.," Sept. 23, '96.

STREET RAILWAY TRUCK CONSTRUCTION AND MAINTENANCE.—By Geo. Neilson. Paper read before the Penn. Str. R'way Convention, Sept. 2, '96. First: No arbitrary specification should be made, regarding foundation, but should be built in accordance with desirability as one goes along. Second: Concrete mixture described. Third: Ties should be 6 inches on face, 7 feet 6 inches long and of white or rock oak and thoroughly seasoned. Fourth: At least 70 lb rails should be used. Fifth: Splices, frogs, grading, wagon traffic form other points of discussion.—"Elec. Rev.," Sept. 23, '96.

USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.—By F. O. Rusling. Paper read before the N. Y. Str. R'way Assoc. at Binghamton, Sept. 8, 1896. Author stated a case where old rails were used practically four in multiple to convey the grounded current back to the station.—"Elec. Engr.," Sept. 23, 1896.

RAILWAYS OF THE WORLD.—In an editorial note the existing mileage of railway is given thus: Europe, 152,422; North America, 203,138; South America, 23,799; Asia, 26,078; Africa, 8,141; Australia, 13,795.—"Age of Steel," Sept. 19, '96.

TROLLEY LINES BETWEEN LAKES ERIE AND ONTARIO.—By Orrin E. Dunlap. The process of constructing this road is novel in several respects.—"Western Elec.," Sept. 26, '96.

Roentgen Rays:

REVIEW OF THE SUBJECT TO DATE.—By Prof. J. J. Thomson. Opening address before the Mathematical and Physical Section of the British Association for the Advancement of Science.—"Electricity," Sept. 23, 1896.

ROENTGEN RAY TUBES.—By W. M. Stine. A contribution on the various tubes in vogue, with a statement of the why and wherefore of special shapes of tubes, anodes and cathodes.—"Elec. World," Oct. 3, 1896.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 6, 1896.

Alarms and Signals:—

NIGHT SIGNALING. R. O. Crowley, Elizabeth, N. J., 568,838. Filed Dec. 12, 1895.

Signaling apparatus employing suitably controlled lights behind colored glass, whereby signals made up of different colored flashes can be made.

STATION OR STREET INDICATOR. E. B. and W. R. Lodge, Cuyahoga Falls, N. Y., 568,859. Filed June 15, 1896.

A roller displaying the names of streets to be passed and means for employing a shunt current from the overhead conductor to rotate the roller at predetermined points. The circuit is closed by a projecting arm at street corners.

LOCK-AND-BLOCK SIGNALING ON RAILWAYS. W. R. Sykes, Jr., and J. P. O'Donnell, of London, England, 568,993. Filed Feb. 6, 1895.

Details of construction.

Switches, Cut-Outs, Etc:—

INSULATED ELECTRIC CABLE. M. Guilleaume, Mulheim-on-Rhine, Germany, 568,756. Filed Nov. 25, 1895.

The insulating material is arranged inside and outside alternate convolutions of windings of fibrous material.

ELECTRIC CABLE. S. P. Thompson, London, England, 568,964. Filed Dec. 19, 1893.

The combination with a single conductor electric cable for submarine use of compensating branches, consisting of an insulated conductor having both a higher resistance and a higher self-induction than the entire length of the main conductor jointed into the cable at some intermediate point and constituting an integral part of the cable.

Dynamos and Motors:—

OSCILLATING RECIPROCATING TRIPOLAR ELECTRIC MOTOR. T. H. Hicks, Detroit, Mich., 568,947. Filed Dec. 19, 1892.

The combination of a solenoid and a magnet, journaled in bearings so as to oscillate together.

Electro-Metallurgy:—

APPARATUS FOR THE ELECTRODEPOSITION OF GOLD OR SILVER. E. Andreoli, London, England, 568,724. Filed July 10, 1895.

Comprises a solution, a tank provided with anodes and a series of amalgamated cathodes, consisting of perforated plates and a layer of mercury in the bottom of the tank into which each of the cathodes dip.

PROCESS OF EXTRACTING GOLD FROM SUBSTANCES CONTAINING IT. H. R. Cassel, New York, 568,741. Filed Feb. 9, 1895.

Employs bromin solutions and regenerates the solution.

PROCESS OF TREATING METALLIC SULFIDS. V. Engelhardt and D. Nettel, Vienna, Austria-Hungary, 568,843. Filed April 20, 1896.

The sulfid is first treated with a reagent consisting of sulfhydrate of the alkalies in aqueous solution and is then decomposed by electrolysis.

Lamps and Appurtenances:—

ELECTRIC SLIDE FOR CHANDELIERS. G. J. Carson, Chicago, Ill., 568,740. Filed Oct. 23, 1895.

Comprises a tube having on its inner surface electric conductors insulated from the rod, but exposed interiorly, and electric connection with the conductors by means of a rod located in the tube.

ELECTRIC ARC LAMP.—R. Scheefbauer, Hoboken, N. J., 568,798. Filed Sept. 24, 1895.

The carbon holders are fitted to slide upon hanging tubes.

ELECTRIC ARC LAMP. N. G. Meade, Jamestown, N. Y., 568,861. Filed May 15, 1896.

Directly operated by the electric current acting upon an electromagnet.

SOCKET FOR INCANDESCENT ELECTRIC LAMPS. J. Pass and A. P. Seymour, New York, 568,919. Filed Feb. 14, 1896.

Porcelain socket. Details of construction.

Miscellaneous:—

MEANS FOR GENERATING ELECTRIC WAVES OR OSCILLATIONS. D. McF. Moore, Newark, N. J., 568,863. Filed Dec. 7, 1895.

Consists in momentarily interrupting in succession a series of induction circuits turning the electric vibrations thus produced in each interruption into a working circuit common to the induction cir-

cuits, and in the intervals between interruptions of each circuit and during the operation of other circuits, connecting each circuit to the source of electric energy. Uses a rotary interrupter.

ELECTRIC MINING MACHINE. R. H. Wiles, Freeport, Ill., 568,-833. Filed May 22, 1896.

The combination with a suitable carriage, of devices arranged thereon to cut a kerf into which the carriage may advance, means for forcing the carriage into the kerf so cut, and a wheel revolubly mounted upon the carriage and arranged to bite into one, only, of the kerf's broader walls, as the carriage is forced forward.

ELECTRIC CLOCK STRIKING MECHANISM. F. E. Girod, Geneva, Switzerland, 569,099. Filed Oct. 11, 1895.

Details of construction.

ELECTRICAL GAS REACTION APPARATUS. A. A. Naville and P. A and C. E. Guye, Geneva, Switzerland, 569,122. Filed Feb. 4, 1896.

Comprises independent aligned tubular electrodes, a tubular collector, insulating tubes connecting the tubular electrodes with the collector, and connections between the electrodes and a suitable source of electricity.

Railways and Appliances:—

ELECTRIC LOCOMOTIVE. J. E. Lockwood, Detroit, Mich., 568,-779. Filed June 10, 1893.

Embodies a supplemental frame supporting the motor gearing, the castings at the sides of the frame connected with the truck frame, the supporting springs and the motor mounted on the frame.

ELECTRIC MOTOR TRUCK. N. C. Bassett, Lynn, Mass., 568,891. Filed March 20, 1891.

Comprises elastically supported motor carrying bars, and an electric motor pivoted thereto in substantially the center of gravity of the machine and geared to the driven axle.

RAIL BOND. H. S. Newton, Syracuse, N. Y., 568,918. Filed Aug. 10, 1896.

Consists of a soft copper bond wire to the end of which are attached metallic end pieces, and means for securing them to the rail.

AUTOMATIC ELECTROMAGNETIC BRAKE FOR RAILWAY CARS. E. A. Hauerwas, Saratoga Springs, N. Y., 569,101. Filed May 23, 1895.

Comprises electromagnetic brakes adapted to engage with a track between the wheels of a truck upon closing a circuit.

Switches, Cut-Outs, Etc:—

SWITCH FOR ELECTRIC HEATING DEVICES. J. E. Meek, New York, and F. L. Powers, Brooklyn, N. Y., 568,783. Filed May 13, 1895.

Obviates the use of a rheostat.

MULTIFUSE CUT-OUT. W. Ehrhardt, Union, N. J., 568,971. Filed Dec. 23, 1895.

Fresh strips can be put on the cut-out to replace burned out or damaged ones without turning off the current or taking the cut-out cylinder from its support.

Telephones:—

TELEPHONE SWITCHBOARD. L. W. Davis, Mineral, W. Va., 568,840. Filed Dec. 5 1895.

Embodies an arrangement whereby all the lines will be always in communication with each other, or with the call bell of the central office.

TELEPHONE. A. Gartnerm, Newark, N. J., 569,018. Filed Feb. 15, 1896.

Embodies a series of balls arranged in the receiver and forming an annular bearing for one side of the diaphragm, and an annular curved flange forming the bearing for the other side of the diaphragm.

REPORTS OF COMPANIES.

A RECEIVER FOR THE E. S. GREELEY & CO.

It is with much regret that we note the collapse of another famous old concern under the pressure of the hard times and bad business, no less a pillar in the elctrical supply trade than The E. S. Greeley & Co. Last week upon application to Judge Lacombe in the U. S. Circuit Court, Gen. E. S. Greeley, president, and J. W. Sands, secretary, were appointed receivers for the concern. The business was established forty years ago by L. G. Tillotson & Company. Gen. Greeley became a partner in that firm in 1865, and in 1884 succeeded to the business after the death of Mr. Tillotson. The firm style was changed to The E. S. Greeley & Company, and the business was incorporated in 1887, under Connecticut laws, with a capital stock of $250,000. The liabilities are $160,000, of which $65,000 is for merchandise and $70,000 due on notes. The assets are $180,600.

LEGAL NOTES.

MR. A. J. DeCAMP'S RIGHT TO BE COUNCILMAN IN PHILADELPHIA.

The prominence of Mr. A. J. De Camp in electric lighting circles renders of interest a decision handed down at Pittsburg by the Supreme Court on October 5 in the case of the Commonwealth of Pennsylvania against A. J. De Camp, appeal from a judgment of ouster.

In 1894, while Mr. de Camp held stock in the Brush Electric Light Company, it entered into a contract for street lighting with the city of Philadelphia. Mr. De Camp was the company's secretary. In February, 1895, he was elected common councilman. The plaintiff claimed he had no right to assume the office. He demurred, but a judgment of ouster was ordered and he was enjoined.

Justice Sterrett says: "When he entered upon the discharge of his duties as Councilman he was interested as an officer and stockholder of the Brush Electric Light Co. in the contract which it had made with the city. Under the facts the court was fully justified in ousting him and, therefore, affirms the judgment."

PERSONAL.

MR. CHARLES A. GRANT. The directors of the Erie Telegraph and Telephone Company have elected Mr. Charles A. Grant treasurer of the corporation, to succeed Mr. Charles J. Glidden, who was recently chosen vice-president. Mr. Grant has been in the service of the company as general cashier and assistant treasurer for nearly fourteen years, and he has a large circle of friends who are well pleased with his advancement.

ANOTHER SET OF UNDERGROUND RAILWAY PLANS FOR NEW YORK.

The Underground Railroad Company of New York City has been incorporated with the Secretary of State. The new company is a consolidation of the Central Tunnel Railway Company, the New York and New Jersey Tunnel Company and the Terminal Underground Railroad Company. The company is organized with a capital stock of $5,000,000, and the directors are Charles C. Vost, of Ridgewood, N. J.; G. A. Liebig, of Brooklyn; Bernard F. O'Connor, Cornelius V. Sidell, Spencer Schuyler, Arthur M. Hatch, William C. Nickoll, James M. Fisk and Raymond L. Ward, of New York City.

According to the papers filed the company will construct an underground railroad in New York City which will be approximately five miles in length. The proposed line of the new road is: Beginning at the City Hall, running northerly to Chambers street, under Reade Street to Elm, northerly under Elm to and under Spring street and Marion or Mulberry streets to and under Great Jones street, northerly under Lafayette place to and under Astor place and Eighth street, northerly under Ninth street to Fourth avenue, northerly through and under Fourth avenue to and under Forty-second street, to the Grand Central Depot, connecting with the Fourth Avenue Improvement Co.

There will be three connecting branches with the main line. One at Thirty-third street, which will run to the East River, connecting with the Thirty-fourth street ferry; a second, beginning at the City Hall Park, running to the East River and southerly along the East River to South Ferry street, and the third starting from the City Hall Park and going to West street and following West street to South Ferry street. It is well understod that the company proposes to use electric traction.

RECENT CONTRIBUTION TO ROENTGEN RAY LITERATURE.

Papers on X-rays still form the staple article of the foreign scientific press. Useful abstracts of these are found both in Wiedemann's "Beiblätter" (No. 8) and in the Physical Society. The latter for September mentions that Messrs. Novák and Sulc have found absorption to increase with the number of atoms in the molecule, and with their atomic weights. Fluorine has an exceptionally high absorption, and bones owe their opacity mainly to fluoride of calcium.——C. Doelter has found that the absorption of X-rays is often anomalous; rock salt, sulphur, potash nitre, and realgar are opaque, considering their lightness; cryolite, corundum and diamond, though heavier, are perfectly transparent. He finds, in contradiction to the last author, that chemical constitution affords no guide, and the direction of the crystallographic axes is also without influence. He proposes a scale of transparency for these rays, consisting of diamond as the most transparent, corundum, talc, quartz, rock salt, calcspar, cerussite, and realgar as the most opaque.——Messrs. Eder and Valenta have failed to shorten exposures by using orthochromatic plates, but have shortened it by heating to 50° C., or by a screen of fluoride of calcium, used with a silver-bromide and celluloid film.——Among the "Beiblätter" abstracts, we find an account of Grunmach's success in discovering phthisis colonies in the lungs of a young man by means of a fluorescent screen, which also was capable of revealing arteriosclerosis of the aorta. M. Levy, in addition, observed the working of the stomach and the heart, which is the most opaque of the internal organs. G. Brandes found that X-rays could be seen if the crystalline lens were removed from the eye. All the humors of the eye are more or less opaque to them.—London "Electrician."

Trade Notes and Novelties

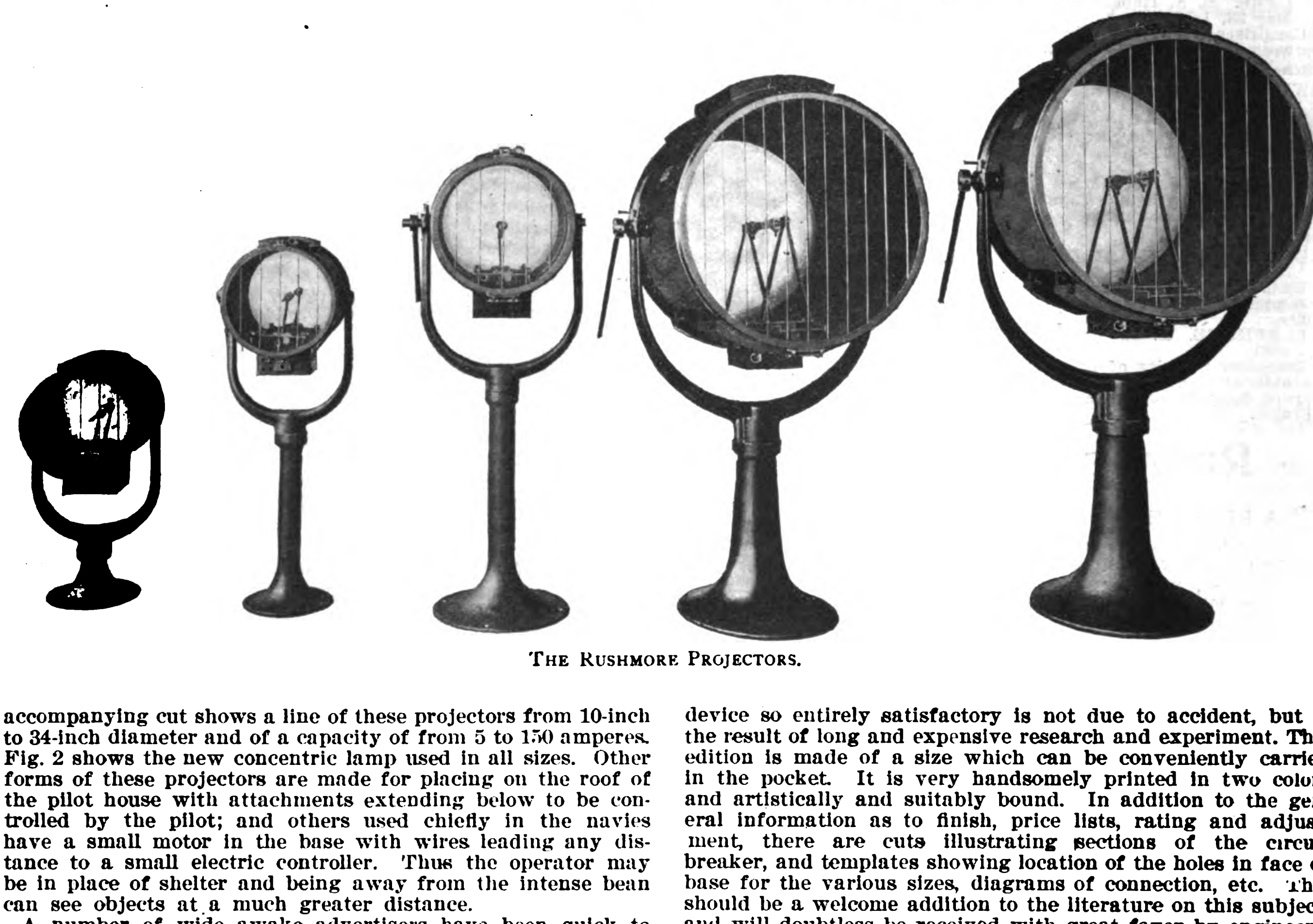
AND MECHANICAL DEPARTMENT.

RUSHMORE PROJECTORS.

OWING to the enormous cost of lenses as made by the old methods there were, it is said, no real searchlights used up to the present year except in the Navies and further, the mechanism employed heretofore has been so complicated and delicate as to render it impractical for use in commercial work.

Early realizing that there was a good demand for a cheap and perfect searchlight, Mr. .. W. Rushmore, who was one of the first in this field, has made a study of the subject, and after long experimenting succeeded in producing the special glass castings required. He has also perfected a machine for their finishing that brought the cost to but a fraction of that by the old methods. He also perfected a lamp mechanism that while containing fewer parts than the common street lamp will feed the heavy carbons toward or away from each other and hold the arc within one volt variation. This is the only arc lamp in use that feeds the carbons in both directions while containing no motors or contact devices of any kind.

This lamp with the new lens mirror, mounted in a sheet metal cylinder, forms the modern high power projector as made by the Rushmore Dynamo Works, of Jersey City. The accompanying cut shows a line of these projectors from 10-inch to 34-inch diameter and of a capacity of from 5 to 150 amperes. Fig. 2 shows the new concentric lamp used in all sizes. Other forms of these projectors are made for placing on the roof of the pilot house with attachments extending below to be controlled by the pilot; and others used chiefly in the navies have a small motor in the base with wires leading any distance to a small electric controller. Thus the operator may be in place of shelter and being away from the intense bean can see objects at a much greater distance.



THE RUSHMORE PROJECTORS.

A number of wide awake advertisers have been quick to appreciate the value of these lights and a number of tall buildings in the large cities are already equipped with powerful lights that throw their rays for miles around and attract the attention of all who may be out of doors. One of these 34-inch projectors is mounted on the lofty tower of the great New York department store of the Siegel-Cooper Company, which burns every night and is said to be clearly visible over 80 miles away.

THE SHOENBERGER STEEL COMPANY, Pittsburg, Pa., have awarded contracts to the Ball Engine Company, Erie, Pa., and Siemens-Halske Electric Company, New York, for a complete electric power plant, consisting of one 400 and one 150 horse-power vertical compound engine, direct connected to 225 kilowatt and 100 kilowatt generators.

EDISON X-RAY APPARATUS.

The Edison Manufacturing Co. are now placing on the market a complete line of Mr. Edison's X-ray apparatus. They are prepared to supply a range of outfits operated by battery power, and also the special high speed break wheel equipment, operated by the Edison current, as exhibited by Mr. Edison at the recent electrical show in this city. No genuine Edison apparatus has up to the present time been sold, as Mr. Edison has wished to bring the appliances to a high degree of perfection before allowing them to be placed on the market.

The Edison Laboratory now has a staff of men employed in making Edison X-ray focus tubes, all of which are manufactured under Mr. Edison's personal supervision.

THE CUTTER CIRCUIT BREAKER CATALOGUE.

The Cutter Electrical and Manufacturing Co. announce a new edition of their "Circuit Breaker Catalogue," complete and accurate as to price and data to October 1. This edition will be known as the "Engineers' Edition." The Cutter Company have been led to bring out a new catalogue by the success which attended the former edition, published in May last. They do so with a hope of giving information as to the scope of their work in this important and, until recently, much neglected field. The protection of circuits carrying heavy currents is a subject of first importance to users of electricity, and the fact that this company has been able to produce a device so entirely satisfactory is not due to accident, but is the result of long and expensive research and experiment. This edition is made of a size which can be conveniently carried in the pocket. It is very handsomely printed in two colors and artistically and suitably bound. In addition to the general information as to finish, price lists, rating and adjustment, there are cuts illustrating sections of the circuit breaker, and templates showing location of the holes in face of base for the various sizes, diagrams of connection, etc. This should be a welcome addition to the literature on this subject, and will doubtless be received with great favor by engineers, for whom it is especially intended.

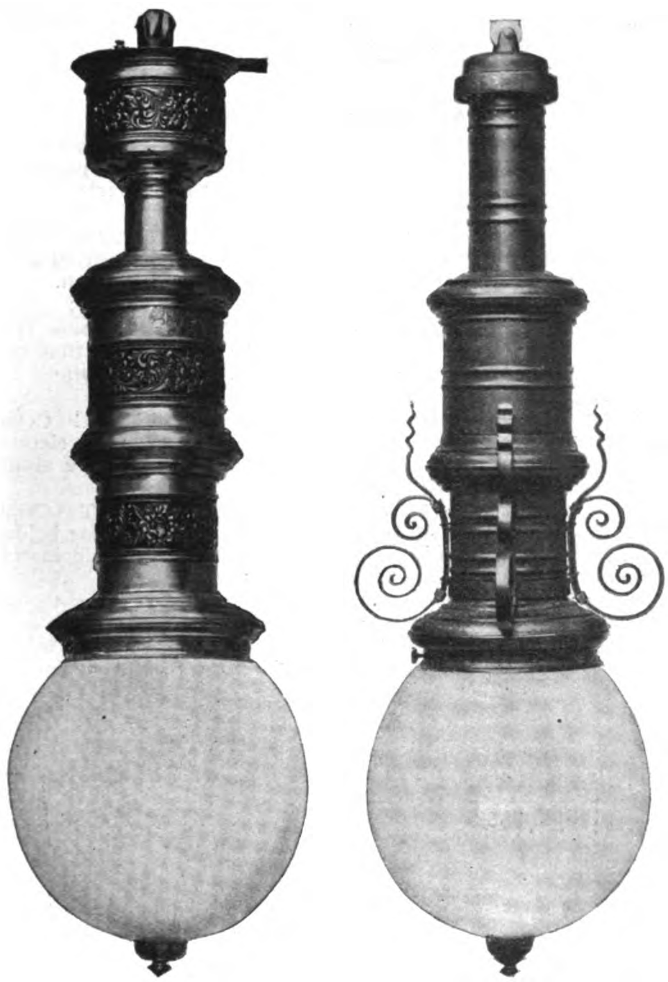
A few pages are devoted to the important details of the well-known C. S. switch, so that the possessor of this catalogue has at hand for immediate reference a concise description of the output of the Cutter factory, well known, as it is, for producing work which is electrically and mechanically of the highest standard of excellence. This catalogue will be sent on application.

THE GEORGE B. INMAN CONTRACT CAMPANY has been formed in this city under the laws of New York, with a capital stock of $10,000, and with G. B. Inman, E. L. Hunt and G. Froh, as directors. The object is to contract for the construction of waterworks, gas and electric light plants and electric railroads.

NEW STYLES OF PIONEER ENCLOSED ARC LAMPS

We have just received from the Electric Arc Light Co. a very neat catalogue announcing four new numbers of "Pioneer" long-hour lamps, and note that considerable improvements have been made in beauty of outline and detail of finish since their first lamp was put in the market.

Their new standard indoor lamp, illustrated in Fig. 1, has a length of 41 inches and is made of polished brass, with three decorative bands embossed with black background. The lamp is entirely enclosed and takes a 12-inch upper and 4¾-inch lower carbon, the globe being opal. Another indoor lamp of the same general appearance is only 37 inches long,



FIGS. 1 AND 2.—NEW STYLES OF PIONEER ENCLOSED ARC LAMP.

but intended for a 10-inch upper carbon. Fig. 2 represents the new style of "Pioneer" outdoor lamp. This lamp is 41 inches long, and finished dead black, with upper carbon 12 inches in length. As will be seen, the lamp is completely weatherproof, no hood or storm protector being required. It is furnished both with and without ornamental scrolls.

Although but a comparatively short time since entering the field, the "Pioneer" lamp has made a host of friends, as witnessed by the strong testimonials of users printed in the Electric Arc Light Co.'s catalogue.

THE COMMERCIAL CONSTRUCTION CO.

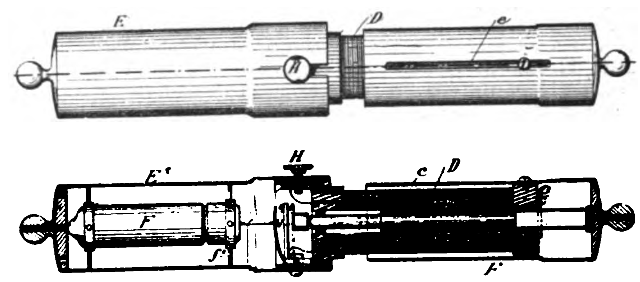
Under the above title a new concern comes forward in New York City for electrical engineering patronage, and with every prospect of doing a large business. It has established headquarters in the Metropolitan Building, Madison Square and East Twenty-third street, and is already engaged with a variety of contract and construction work. The president of the new company is Mr. A. J. Martin, who, though young, has already had a very active career in the field of electric lighting manufacture and installation, and whose latest achievement was his work as the electrical engineer of the Electrical Exposition, at the Grand Central Palace, last May, where a gigantic task had to be put through successfully in a very short time. Associated with him as treasurer of the concern is Mr. Geo. Hilliard and Mr. G. M. Still, a leading oyster merchant, who is secretary. The company will be glad to hear from all parties requiring responsible work done promptly, and will be glad to give estimates with regard to electric railways, electric subways, electric lighting, wiring, telephone plants, etc.

THE LEVY POCKET FARADIC BATTERY.

The accompanying engravings illustrate an improved portable faradic pocket battery.

The exterior casings of the battery form the electrodes and serve as an inclosure for a dry cell, F, and the induction coil, so that the battery can either be held by both ends in the hands or held at one end in one hand, while the remaining part is applied by means of a sponge or other electrode to the part of the body to be treated.

On the reduced portion of the tubular parts surrounding the core are arranged the usual primary and secondary windings of the induction coil, D. The induction-coil is inclosed by a sliding sheet-metal casing, E, which is guided by a longitudinal slot. The end of the metallic sliding casing, E, is made with a hollow knob, so as to form connection with an



electrode, if one is to be used in connection with the battery. For ordinary purposes the sliding casing forms one electrode of the battery. At the interior of the sliding casing, E, is fixed a brass tube, which fits over the core when inserted into the induction-coil and which serves as a damper, which can be drawn in or out.

The secondary winding is connected with a metallic block attached to the interior hollow portion. When, therefore, the switch-screw, H, is turned in sufficiently so as to form contact with the casing, E', the circuit is closed and the induction-coil operated by the battery. By removing the casing, E, sponges, brushes or other electrodes can be applied to the induction coil whenever special application to the body is made, the combination being then held by the casing, E', which forms the other electrode.

This handy combination is the invention of Mr. Leo Levy, of New York.

BALL ENGINES FOR RUSSIA.

The Ball Engine Co., Erie, Pa., the celebrated builders of automatic engines for electric purposes, have recently shipped several engines to Mexico, and one 200 horse-power to Russia. They have an order at the present time for one 400 horse-power vertical cross compound condensing engine, direct connected to Siemens-Halske Electric Co. generator, to be used for electric power in a large steel works at Marlepol, Russia.

TUBING CHICAGO SKY-SCRAPERS.

The Silversmiths' and the Stewart Building are Chicago's two latest additions to its long list of towering office buildings. The Electric Appliance Company are particularly interested in the construction of these two mammoth buildings, as they are to tube them throughout with Armorite.

EDWARD R. KNOWLES.

Mr. Edward R. Knowles, E. E. C. E., long and favorably known in engineering circles as an expert electrical, civil and mechanical engineer, has opened an office in the Tract Society Building, 150 Nassau street, New York, where he will continue his practice as a consulting engineer, making the application of electric power a specialty in addition to his regular engineering work. Mr. Knowles is consulting electrical engineer to the New York and Brooklyn Bridge, having charge of the installation of the new electric traction system which is being introduced in place of the cable traction system now in use. He is also consulting engineer to the "New York Journal," the Mergenthaler Linotype Company, Blake & Williams, and other like corporations. Mr. Knowles has had a long and varied experience in designing, manufacturing and installing electrical machinery. He is prepared to act as expert and engineer in making examinations and

reports, drawing up specifications, laying out and designing electrical installations and supervising the erection of the same.

TELEPHONE LINE MATERIAL.

The demand for telephone line material during the past year has been one of the features of the electrical supply business, and has tended to somewhat relieve the depression caused by the smallness of the demands for electric light material. The Electric Appliance Company has been one of the first companies to recognize this demand, and prepare for it by putting in a liberal stock of telephone line material. It is carrying in Chicago immense stocks of special telephone cross arms, pony insulators, galvanized telephone wire, etc., and is at present prepared to supply almost any demand for these goods.

H. W. JOHNS CO. AT THE CONVENTION.

The H. W. Johns Manufacturing Company will be represented at the St. Louis convention by Mr. J. H. MacLennan, of St. Louis, H. A. Reeves, of the Chicago branch, J. W. Perry, of Philadelphia, J. Emory Meek, of their New York office, and E. B. Hatch and Herbert Luscomb, of the Johns-Pratt Company, Hartford, Conn. The company's exhibit will consist principally of the "H. W. J." car heaters and the well known Moulded Mica line materials and Vulcabeston insulating parts. The Johns Company has revived the sale of the "Hercules" mechanical clip, which is specially adapted for holding the "8"-shaped trolley wire. An exhibition car in the space of the American Car Company will be equipped with the "H. W. J." car heaters.

WHERE TIME IS MONEY.

Calculagraphs are now in constant use for calculating and printing in minutes and fractions of a minute the time which has elapsed in the transmission of toll messages in the following telephone exchanges, viz., American Tel. & Tel. Company (long distance) New York, N. Y.; Buffalo, N. Y.; Troy, N. Y.; Avon, N. Y.; East Onondaga, N. Y.; Boston, Mass.; Springfield, Mass.; West Boylston, Pa.; Philadelphia, Pa.; Temple, Pa.; Hazleton, Pa.; Harrisburg, Pa.; South Williamsport, Pa.; Altoona, Pa.; Maumee, Ohio; Tadmor, Ohio; Cincinnati, Ohio; Cleveland, Ohio; Baltimore, Md.; Terre Haute, Ind.; Evansville, Ind.; Indianapolis, Ind.; Waterloo, Ind.; Providence, R. I.; St. Louis, Mo.; Chicago, Ill.; Milwaukee, Wis.; Washington, D. C.; The Southern Massachusetts Telephone & Telegraph Company, New Bedford, Mass.; Fall River, Mass.; Taunton, Mass.; Brockton, Mass.; Southern New England Telephone Company, New Haven, Conn.; Hartford, Conn.; Bridgeport, Conn.; Waterbury, Conn.; Wisconsin Telephone Company, Milwaukee, Wis.; New England Telephone & Telegraph Company, Boston, Mass.; Worcester, Mass.; Springfield, Mass.; Salem, Mass.; Pittsfield, Mass.; Northampton, Mass.; North Adams, Mass.; Gloucester, Mass.; Greenfield, Mass.; Haverhill, Mass.; Lawrence, Mass.; Lowell, Mass.; Lynn, Mass.; Bellows Falls, Vt.; Concord, N. H.; Manchester, N. H.; Nashua, N. H.; Portland, Me.; Lewiston, Me.; Bangor, Me.; Central Union Telephone Company, Columbus, Ohio; Indianapolis, Ind.; Peoria, Ill.; The Bell Telephone Company of Philadelphia, Philadelphia, Pa.; Pacific Telephone & Telegraph Company, San Francisco, Cal.; Chicago Telephone Company, Chicago, Ill. The Calculagraph is also in use in London, Paris, Berlin, Antwerp and Gothenburg, Sweden.

RAILWAY ARC LAMP.

The need of an arc lamp to operate satisfactorily on the 500 volt circuits of street railway is met by the type brought out by the General Electric Company in 1893 and recently improved. These lamps may be placed in any location where arc lamp light is required, running them in series of ten for the usual street railway voltage. They are automatic in action, simple in construction and require no more attention than the common series arc lamp. Variation of pressure on the trolley or feeder line is taken care of by a rheostat in the circuit.

While such lamps find ready use in the carbarns and around stations, the growing establishment of pleasure resorts, picnic grounds, music pavilions, waterside parks, etc., on the lines of street railways has created a large demand for them. Especially designed for use on trolley circuits, they form the only practical means of illuminating such large areas on the railway line as those mentioned above, and while lending an air of attraction, give a soft light which interferes in no way with the enjoyment of the surroundings, and the sentiments which the summer and fall evenings are supposed to bring in their train.

MICA INSULATOR CO.

Their exhibit at the St. Louis convention will consist in micanite in its various forms, such as commutator segments, rings, tubes, troughs, insulating cloth and paper and peculiar forms of insulation for various types of electrical machinery. Eugene Munsell & Co. will exhibit mica in the sheet, commutator segments and mica as it comes from the mines. Their exhibit will be one of special interest to electricians and superintendents of motor equipment.

A very pretty mica souvenir has been gotten up and will be given to the visiting delegates. A generous supply of blotters will also be distributed, which will remind visitors of the fact when they reach home the place to send their orders for insulation in any form is 218 Water street, New York City, and 153 Lake street, Chicago, Ill. Both the Mica Insulator Co. and Eugene Munsell & Co. exhibit will be in charge of Charles E. Coleman, manager of the Chicago office.

ADVERTISERS' HINTS.

MR. L. S. MARSH, Howell, Mich., invites correspondence with those interested in gas engine plants for private purposes. Mr. Marsh is a consulting and constructing electrician and makes this branch a specialty.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY have just issued a new catalogue of their "I-T-E" circuit breakers, which will be mailed on application.

THE COLBURN ELECTRIC MANUFACTURING COMPANY, Fitchburg, Mass., illustrate in their "ad" a new type of their well known dynamo. It will be remembered that this company devote particular attention to their machines for electro-plating.

THE HART & HEGEMAN MANUFACTURING COMPANY have brought out a new indicating switch for electric car heaters, breaking circuit at four points. They are single pole and made for 10 amperes at 500 volts.

THE WESTON ELECTRICAL INSTRUMENT COMPANY show a style of their portable galvanometer for bridge work. This is but one of a complete line of portable instruments made for all conditions of service.

THE STANDARD AIR-BRAKE COMPANY refer to the U. S. statutes requiring the equipment of all freight cars with air-brakes before December 31, 1897, and ask: "Which is the more important, the safe transportation of freight or passengers?"

NEW YORK NOTES.

A. K. WARREN & CO., of this city, whose plant was destroyed by fire in the early part of the summer, have in no wise been hindered by the misfortune. After a summer of unusually good business, they are now situated at 451-53 Greenwich street and 15-21 Desbrosses street, where they have larger quarters than before, and improved facilities for carrying on their work. With an undaunted energy they are pushing to secure whatever new and old work offers in their field.

GEO. CALLAHAN & COMPANY, 154 South street, New York, are finding in the electrical field a large market for their specialties. Among these are their belt dressing and their steam joint cement. The belt dressing is very popular and has proved eminently serviceable, besides being reasnoable in price and economical in use. It has been tried and not found wanting, by several electric light companies, and among those in this vicinity may be named the Flemington, Deckertown and Harrison Edison plants in New Jersey. Callahan's steam joint cement is also in extensive use for flange joints, tank joints, piping, screw joint, man holes, hand holes or any other place difficult to keep from leaking. It is a favorite with such concerns as the New Bedford Gas & Electric Light Company, the General Electric Company at Schenectady, the Edison Company in Philadelphia, and the United Gas Improvement Company, as well as hosts of other concerns who cheerfully speak in its praise.

NOTHING is more important in steam work than the joints Leaks at those spots may cause endless annoyance and expense. Just so in electrical work. For want of a good insulating washer or bushing an otherwise excellent piece of apparatus may be rendered useless. Mr. A. O. Schoonmaker, 158 William street, New York, has given special attention to the manufacture of mica washers and bushings of high insulating qualities, and manufactures them in all sizes or thicknesses for any kind of work. He will be glad to forward samples for inspection and trial.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

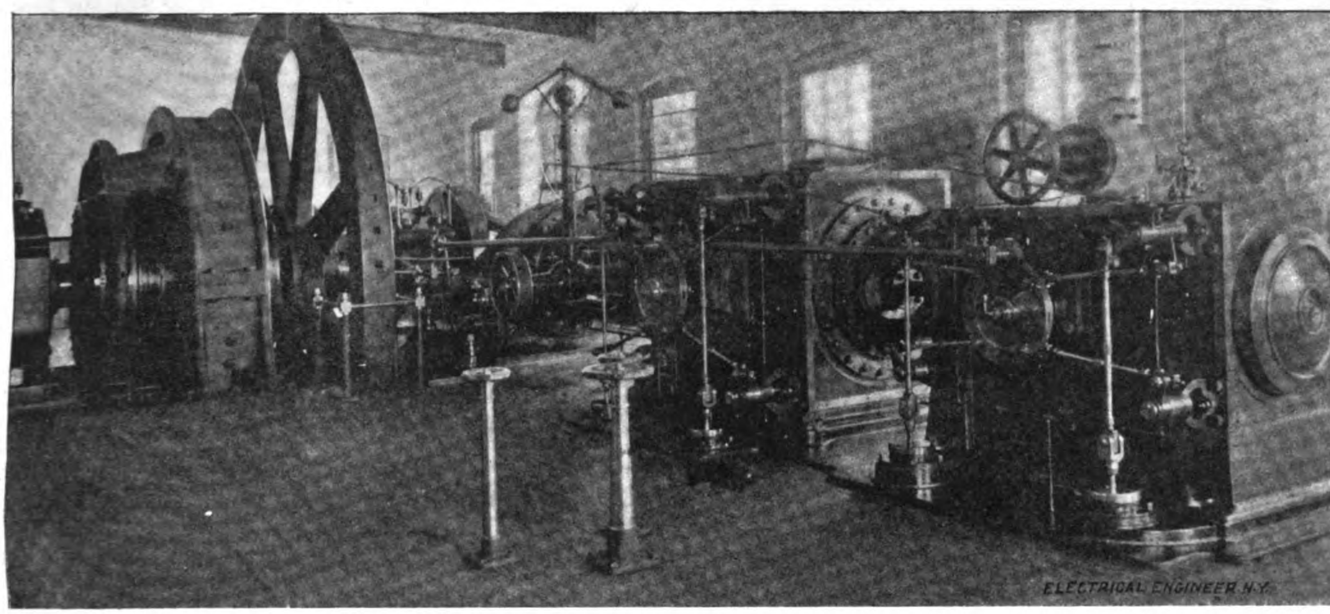
Vol. XXII. OCTOBER 21, 1896. No. 442.

Electric Transportation.

THE FAIRMOUNT PARK TRANSPORTATION CO., OF PHILADELPHIA,—ITS PLANS AND WORK.

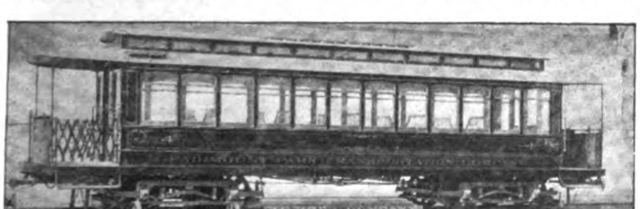
THE first step toward the construction of the road of the Fairmount Park Transportation Co. was taken on July 6, 1889, when the Commissioners of Fairmount Park granted to William Wharton, Jr., a license to lay down, construct, operate and maintain for the term of fifty years from date a passenger road in Fairmount Park. The route, as originally adopted, differs but slightly from the final location. The route in the West Park begins at the intersection of Belmont and Elm avenues, thence with double track skirting the boundary of the park, via George's Hill, to Belmont Summit, near the head of the old inclined plane. From this point a loop extends along the beautiful wooded slopes and hillsides near the Schuylkill River, to Chamounix and the lakes. Thence closely following the northern boundary of the park, it joins the double track at Belmont Summit.

The line is about seven miles long, single track measurement. There is also a branch railway with double track beginning at Ridge avenue, Twenty-third and Dauphin streets, passing Strawberry Mansion, crossing the Schuylkill on a steel bridge, ninety feet high, and connecting with the tracks in the West Park. The railway connects in both the East and West Parks with all the railways running to the park, and is so situated that passengers can be brought to the road by both the Reading and Pennsylvania Railroads. The territory traversed by the road is a part of the park that is practically unexplored by the public, and its opening will mean the enjoyment of a beautiful and heretofore non-frequented region of the park.

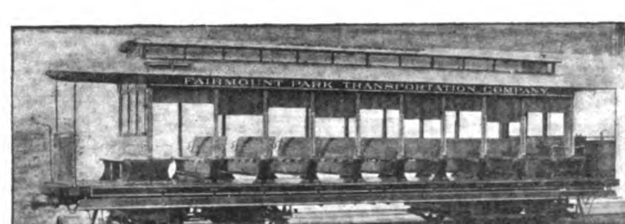


INTERIOR OF POWER HOUSE, FAIRMOUNT PARK ELECTRIC RAILWAY, PHILADELPHIA.

The power house and car house are erected on the line of the Pennsylvania and Reading Railroad, on the westerly bank of the Schuylkill, near the Columbia bridge, and are so situated that coal can be delivered either by railroad or canal at the lowest cost and with the greatest possible advantage. Passenger stations are placed along the road at all desirable points, and stops are confined to these stations. The steam engines, boilers, generators and all other machinery and appliances are of the most approved types found desirable for economy



CLOSED CAR, FAIRMOUNT PARK ELECTRIC RAILWAY.

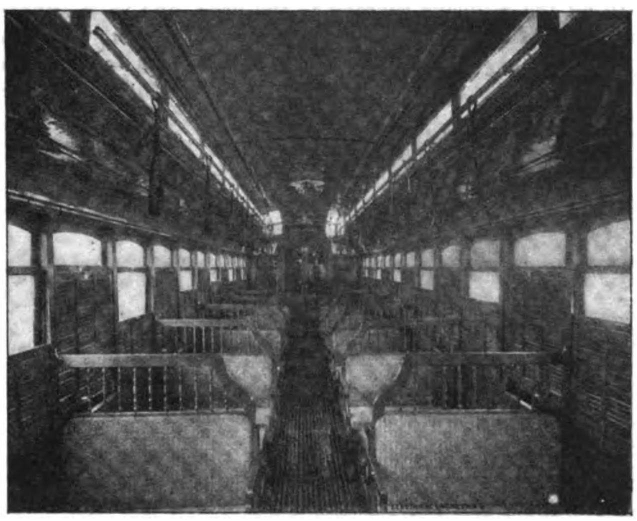


OPEN CAR FAIRMOUNT PARK ELECTRIC RAILWAY.

Bridge Across the Schuylkill for the Fairmount Park Trolley Road.

and service. The fare for the round trip is 5 cents, and in company with adults children under five years of age are allowed to ride free. This feature will add largely to the popularity and business of the company.

Although the main part of the business will consist in carrying people for pleasure, yet there must of necessity be a large amount of travel over the line, as it will provide a short cut from the northern and northwestern parts of Philadelphia



Interior of Fairmount Park Railway Car.

to West Philadelphia. This will include Germantown, Roxborough, Manayunk, Falls of Schuylkill and all the adjacent localities which the extended area of the park has up to this time cut off from all direct railway communication with other sections of the city.

No grade crossings exist at any roadways, bridle paths, or foot paths, and the tracks over the Schuylkill bridge are entirely separated from carriage and foot travel. All ravines and roadways are crossed, when overhead, by steel viaducts, and when below grade by stone masonry tunnels.

The cars used are eight-wheeled Brill cars, having a seating capacity for seventy-two persons. They are made up into trains consisting of one motor car and one trail car. The motor cars are equipped each with four "G. E. 1,000" motors, electric brakes, and two K. 4 controllers, which regulate the current actuating both motors and brakes. The trail cars are equipped with electric brakes on all four axles. Both motor and trail cars are equipped with especially powerful hand brakes in addition to those already mentioned. At present the road is supplied with sixty cars, thirty motor and thirty trailers.

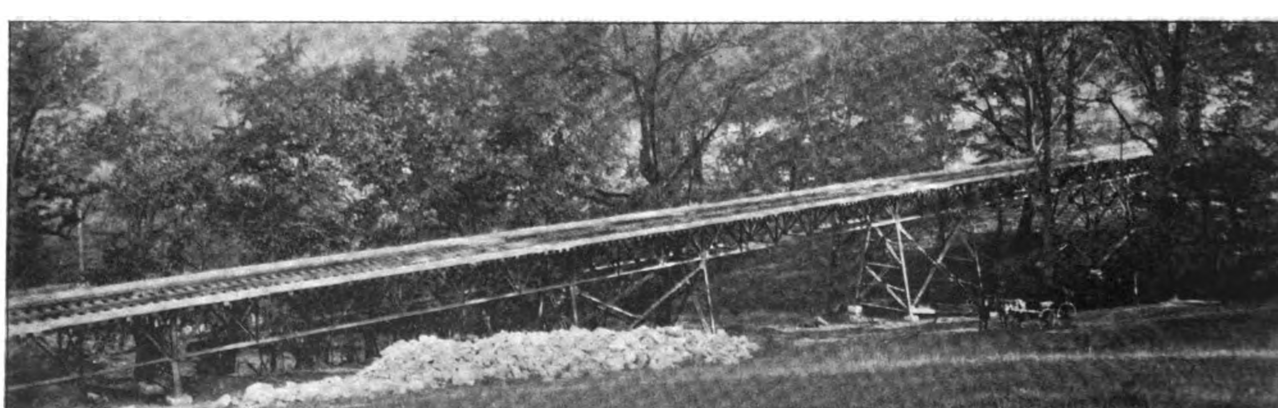
The roadway is graded so that there is no ascending grade greater than four per cent. slopes, banks and space between tracks being filled to the top of the rail, and sodded or planted with grass seed. To make the permanent way as little unsightly as possible, the slopes are made of warped surfaces,

Arch for Carriage Drive, Fairmount Park Electric Railway.

so as to avoid a rectilinear perspective. The cuts are very open and planted with shrubbery.

The track and overhead construction are of especially heavy character. The rails are 90-pound T rails, 36-inch angle bars, with cast iron chairs at the curves. The bonding is the Harold P. Brown plastic bond. These are put in double. The rails are connected to the negative bars with ten 1,000,000 circular mils copper cables, whereby a smaller drop of potential in the ground circuit is obtained than in any other road constructed up to the present time.

The feeder system is made up of a number of braided lead encased paper covered cables of 500,000 and 650,0000 c. m. The maximum drop of potential in the entire system is 10 per cent. The average drop will be under 5 per cent. The cables are drawn into a subway of the ordinary type, built of

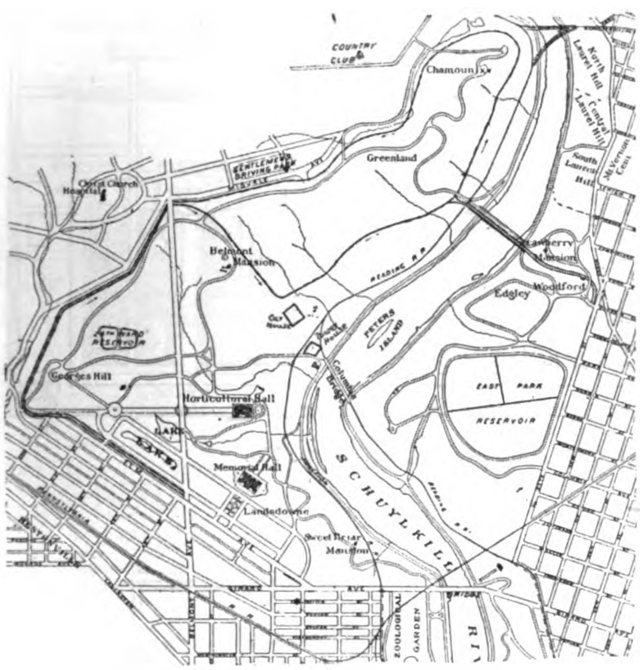


A Viaduct of the Fairmount Park Electric Railway, Philadelphia.

treated wood ducts, the distance between manholes averaging 500 feet. The trolley wire is of No. 0000 hard drawn copper, with especially heavy poles, span wire and fittings. In fact, owing to the unusually severe service to which this road will be subjected, more like that of a steam railroad, the entire construction and equipment is of an extra substantial character. This has, therefore, made special construction necessary.

The agreement with the Park Commission having prevented any grade crossings, the total number of bridges, including that on the Schuylkill River, is twenty. These are all of the highest grade of work, both from the standpoint of the engineer and of the artist, as shown in some of the accompanying illustrations. The bridge over the Schuylkill River is to have a forty-foot roadway for carriages. On the north side of this roadway is a twelve-foot sidewalk, while on the south side are the two railroad tracks. The bridge will be paved with asphalt, and will be lighted by twelve arc lamps on ornamental posts. The current for these will be supplied by the railway company.

The rolling stock consists of thirty motor and thirty trail cars, as mentioned above. These are each mounted on two



PLAN OF FAIRMOUNT PARK ELECTRIC RAILWAY.

four-wheel trucks. The wheels are thirty-three inches in diameter, and four inches tread, with extra heavy flanges.

The car shed is 425 feet long by 114 feet wide, constructed in two bays. Aside from its substantial character and handsome exterior, as required by the Park Commission, it differs but little from the regular car shed of the larger roads. Every effort has been made to have the powerhouse an ornament to the park. It is built of two shades of Pompeian brick, with granite belt courses and a base course, eight feet high, also of granite. The cornice and ornaments, pipes and roof balustrade are of copper. The roof is of slate. There are skylights in the roof of the engine room.

The engine room is 156x55, and the boiler room 156x36. Extending under the tracks of the Pennsylvania and Reading Railroads is a coal vault entering into the boiler room of sufficient capacity for storing one month's supply of coal.

The station is equipped with three tandem compound Corliss engines directly connected to 500 K. W. General Electric generators. They move at a speed of 90 revolutions per minute. These engines were built by Robert Wetherill & Co., of Chester, Pa., who also furnished the boilers. These are of the Berry vertical type, have water grates and fire tubes. There are six boilers each of 250 horse-power. The condensers and pumps are furnished by the Blake Co. The air pumps are of the twin vertical type, admiralty pattern.

Instead of a stack or chimney, induced draught and an economizer is used. Experience in Philadelphia has shown that this arrangement not only effects a great saving in coal, but is of further benefit in that it diminishes the scale in the boiler. In cases where the economizer has appeared not to pay for the cost of installing, its failure, on investigation, has been found to be due to mismanagement. The engine room is equipped with a 20-ton traveling crane, made by William Sellers & Co.

The officers of the Fairmount Park Transportation Co. are as follows: President, George S. Gandy; secretary and treasurer, Ellsworth H. Hults; engineers, Edward B. Ives and Axel H. Engstrom; engineers in charge of construction, T. A. Merryweather, permanent way; W. N. Walmsley, electrical; A. Kuylenstjerma, mechanical.

ST. LOUIS ELECTRIC RAILWAY POWER STATIONS.

ST. LOUIS was among the first of our large cities to adopt electric traction and, with possibly a single exception, has the largest mileage of electric railway of any city in the country. Having begun comparatively early to avail itself of the facilities offered by the electric method, the stations of the various companies present excellent examples of the rise and growth of the art and the gradual replacement of old by improved apparatus, as experience has been gained in operation. The members of the American Street Railway Association, now convened at St. Louis, will therefore have an excellent opportunity of making comparisons and drawing conclusions from the work of their St. Louis brethren, some of whom have paid dearly for their experiences. We cannot, within the limits of the space at our command, enter into a detailed description of each station, but we have selected from among them a number which will give a good idea of their general character.

UNION DEPOT RAILROAD POWER STATION, NO. 1.

Perhaps as good an example of the changes and progress made in electric railway power house equipment as could well be found is that presented by the Union Depot Railroad Power House, No. 1. This station was designed at the time when the best practice was considered to be the operation of a large number of small units belt driven from countershafts, and when direct connected units had hardly entered the domain of discussion, let alone of practice, in railroad work. With the lapse of time the apparatus was changed until at present the station contains just enough of the older type of apparatus to make all the more striking the great strides during the past six or seven years.

The station is situated on the block bounded by Geyer, Missouri, Allen and Jefferson avenues. The original station was started early in 1890, then occupying a space 85 x 129 feet for the engine room and 54 x 109 feet for the boiler room.

The initial engine plant consisted of two Hamilton-Corliss engines, one 24 x 48 inches, and the other 20 x 48 inches. These engines were belted to a jackshaft, which in turn drove a 6-inch countershaft by means of a one-inch rope drive. The dynamo equipment consisted of 14 Thomson-Houston D 62 dynamos, which were likewise driven from the countershaft by means of a ¾-inch rope drive. Experience, however, soon proved the rope drive to be unreliable and belts were substituted in their stead. Increase of traffic during the first year's operation necessitated an addition to the power plant and an extension of the building was erected and another engine added, together with eight additional dynamos, making twenty-two in all.

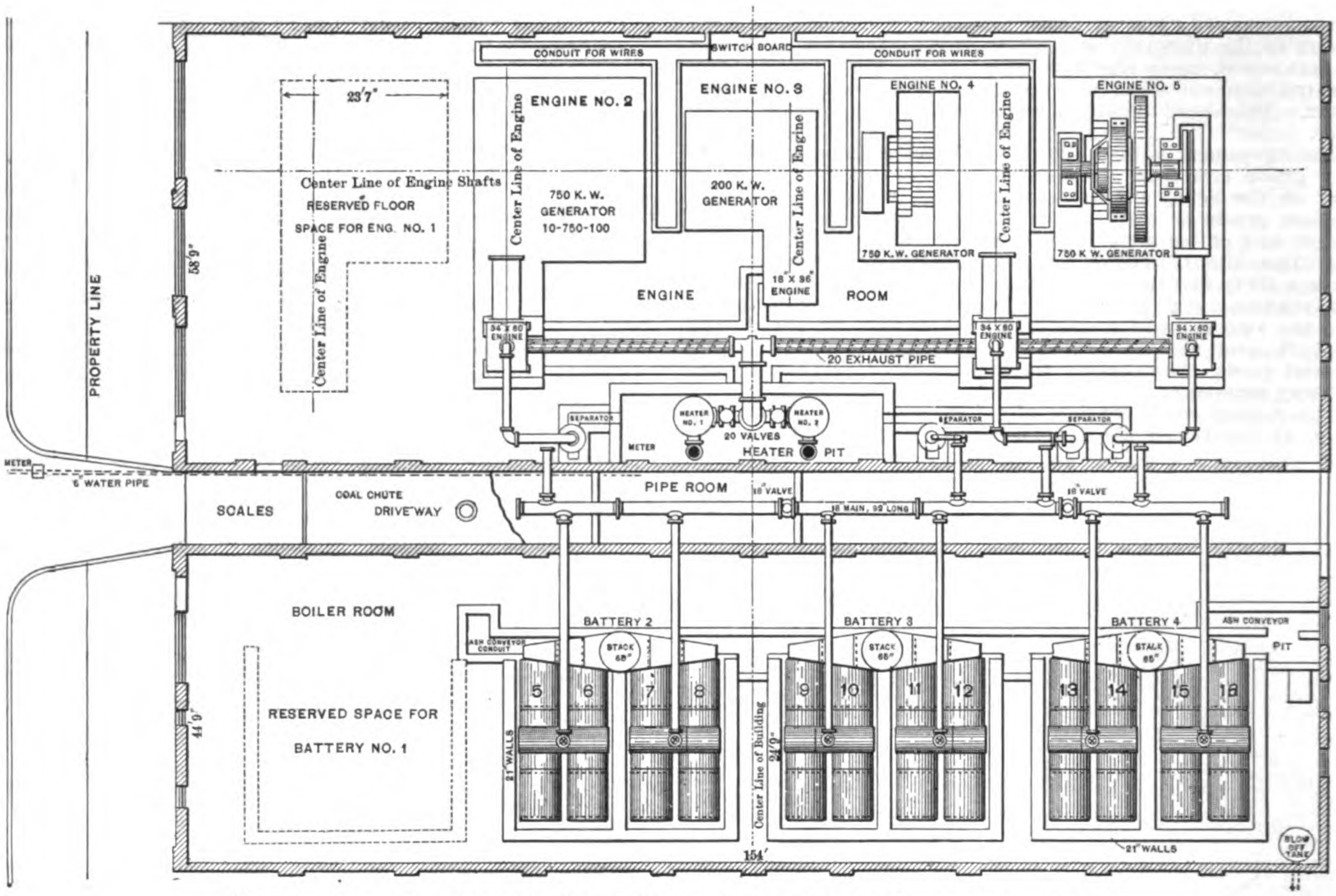
It was not long, however, before further demands were made upon the station, which was enlarged to the dimensions shown in the engraving, p. 388. The equipment early in 1895, consisted of two Porter-Allen engines, 20 x 36 inches, direct coupled to two General Electric M.P. 400 generators and seven D62 Thomson-Houston generators, driven by a 28 x 34-inch Hamilton-Corliss engine, together with eight 250 horse-power Heine boilers. The original equipment of the D62 dynamos with their engines being thrown out of service, was removed from the station. In the fall of last year a General Electric 1,500 kilowatt generator, direct coupled to two Allis engines, was installed with an addition of two 500 horse-power Heine boilers. This unit is the largest in the city.

The destructive cyclone which visited St. Louis in May last, nearly destroyed the entire plant, the two brick smokestacks falling upon the engine house. Most of the machinery was repaired, however, but the engines constituting the original plant have not been put in service since the disaster.

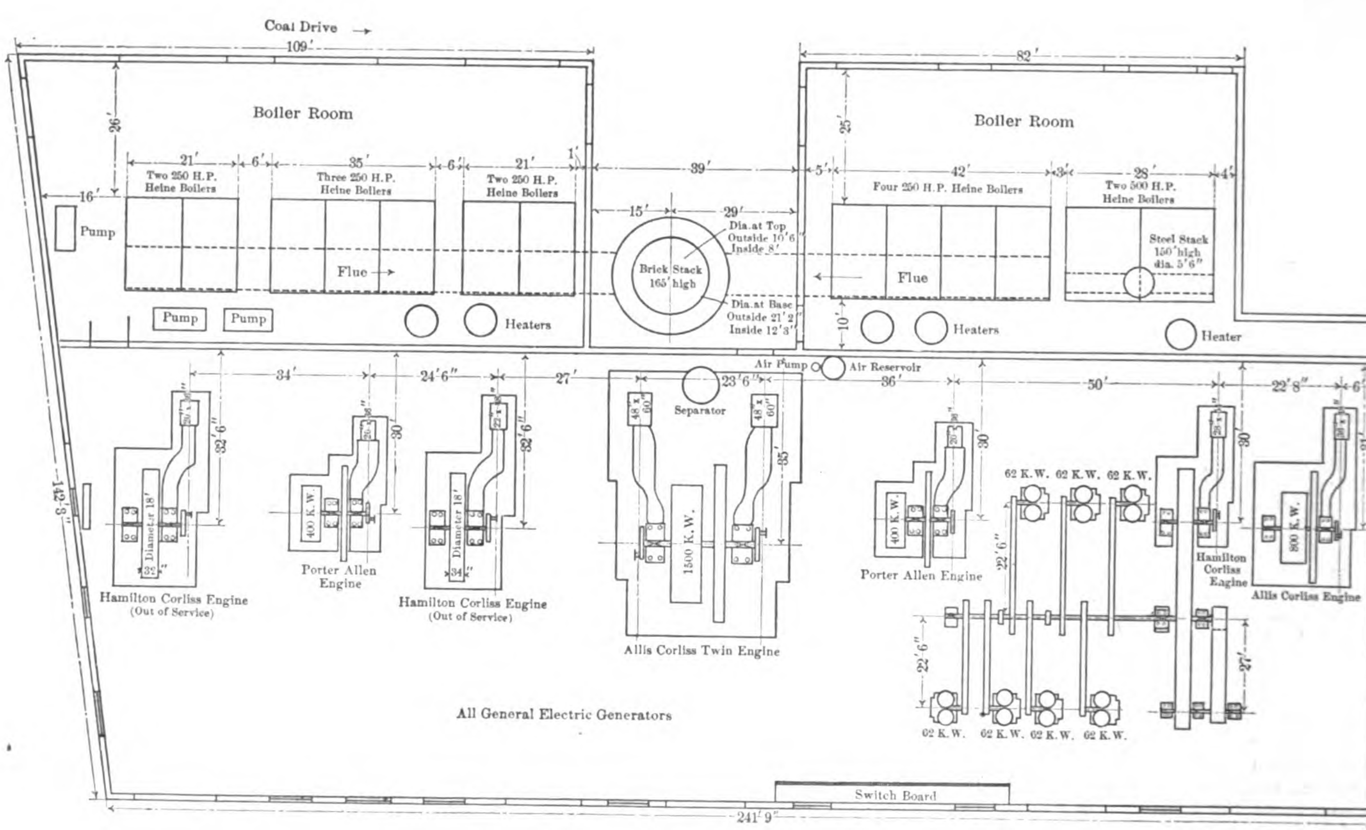
The Union Depot Railroad also operates another power house in North St. Louis.

THE ST. LOUIS AND SUBURBAN RAILWAY POWER STATION.

As was the case with a number of companies in St. Louis, the St. Louis and Suburban Company, operated originally the cable system, but the owners were soon converted to the benefits of electricity. The cable power house proving too



Plan of Power Station, Cass Ave. & Fair Grounds Railway Co., St. Louis, Mo.



GEYER AVENUE

Plan of Power Station No. 1, Union Depot Railroad, St. Louis.

small for the electric requirements, the new power house was located at De Hodiamont, close beside the Wabash Railroad track, and went into operation in the fall of 1891. The original electric equipment consisted of eight 75 kilowatt and two 80 kilowatt generators driven from countershaft by Hamilton-Corliss engines. Three batteries of two boilers each were installed at the same time, the entire equipment being placed on the side facing Vendome avenue, in the engraving below. A month after the plant had gone into operation, the old cable plant was abandoned and its engines removed to the new electric power plant, forming a twin arrangement with the one already installed.

Two years later, in 1893, the engine room was extended and two additional Thomson-Houston 80 kilowatt generators installed driven by a Hamilton-Corliss engine, which was taken from the older portion of the house. Another change was made by taking one of the twin engines and moving it to the east end of the station, where it is belted to two Thomson-Houston, 300 horse-power dynamos. Additional power was also gained by extending the line shafting and belting to it two 270 horse-power generators. The rearrangement is shown in the diagram of the plant.

During the past year the St. Louis and Meremec River Railroad was built, which road had entered into a contract with the Suburban Company, to furnish it with power. This necessitated still further additions to the generating plant. They were begun early this year, and consisted of a 60-foot extension to the engine room and 118 feet to the boiler room. Two Hamilton-Corliss engines direct connected to two General Electric 800 kilowatt generators were put in and eight new boilers added.

The boilers in this station have all been provided with the Hawley down draft furnace and each battery has a steel stack 150 feet high. The boilers are fed with city water. This can be led directly to the pumps, to the heaters, or to the boilers, or to hot wells in the boiler room. The water of condensation from the exhaust pipes, traps, etc., is discharged into the south well. All scum and dirt rising to the top is run off into the sewer, leaving the north well clean so that its water can be pumped into the boilers. The general practice, however, is to run the water through the heaters and pumps and then to the boilers. Four closed heaters are installed at this station, two Goubert, one O'Brien, and one Baragwanath.

THE CASS AVENUE AND FAIR GROUNDS RAILWAY COMPANY'S POWER STATION.

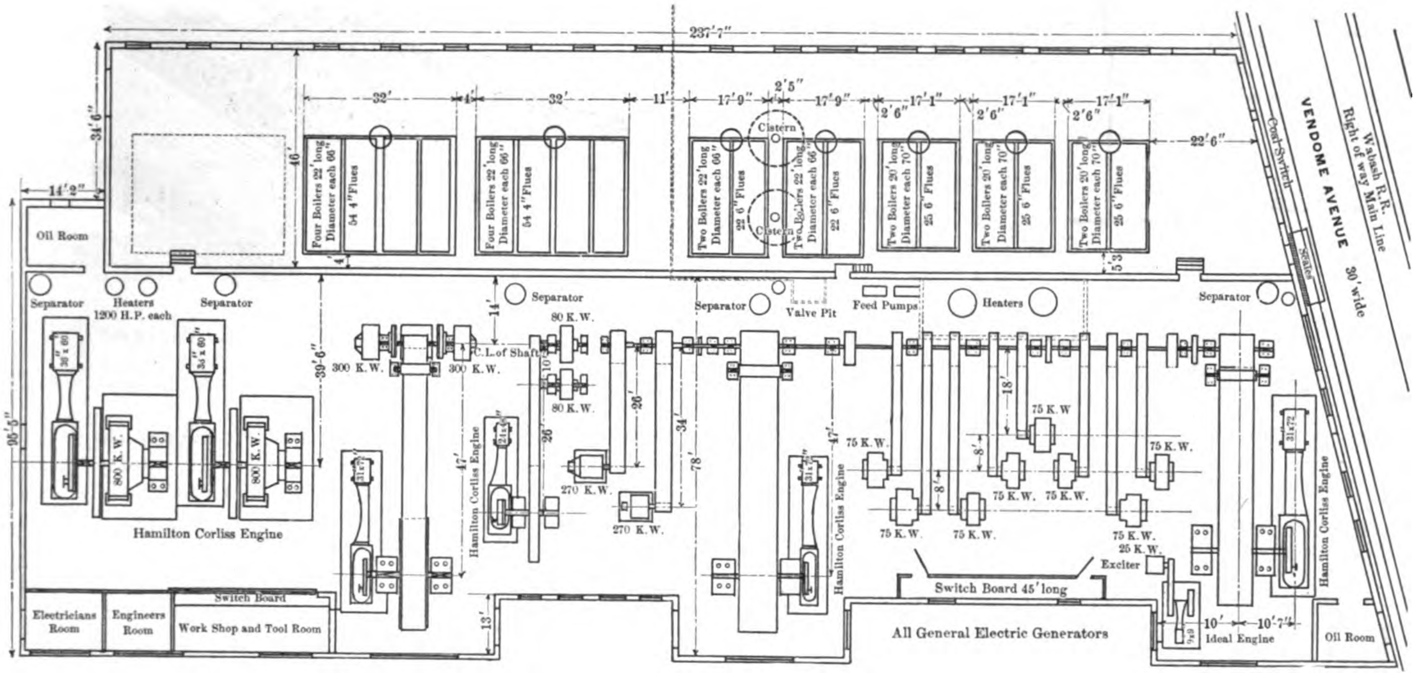
The Cass avenue and Fair Grounds Railway is one of three systems controlled by the National Railway Company, the other two stations operating cable roads.

The Cass avenue Station plant is modern in every respect, consisting of four Corliss engines, three of which are direct connected to 750 kilowatt General Electric generators, and one unit of 200 kilowatt capacity. Indeed it is worthy of special note that the apparatus in this plant was the first of the direct-connected type for railway work installed by the General Electric Company.

The plant was originally intended to operate 70 motor cars. Since then over 100 motor cars have been added, as well as numerous trailers. This has been done without increasing the power equipment at the station.

The boiler room contains twelve tubular boilers 22 feet by 66 inches, with a total capacity of 3,000 horse-power. The Hawley down draft furnace is employed. The grates consist of two-inch water pipes which connect with two water drums at either end of the fire box. The draft being down, the fire is brought in contact with the water pipes forming the grates, thus adding materially to the steaming capacity and efficiency of the boilers.

The arrangement of the boiler house permits of the ready handling of coal. The floor of the boiler room is 12 feet below that of the engine room and is separated from it by a driveway. The coal carts enter this driveway and dump the coal through manholes into chutes which lead directly to the front of the boilers. An excellent system of station accounts is kept and records are made of the performance of engines and dynamos. These records are regularly worked up and the results entered in books kept specially for that purpose, and reduced to coal and water consumed per motor car miles run. In calculating the total number of motor car miles, a trail car mile is taken as equivalent to one-half a motor car mile.



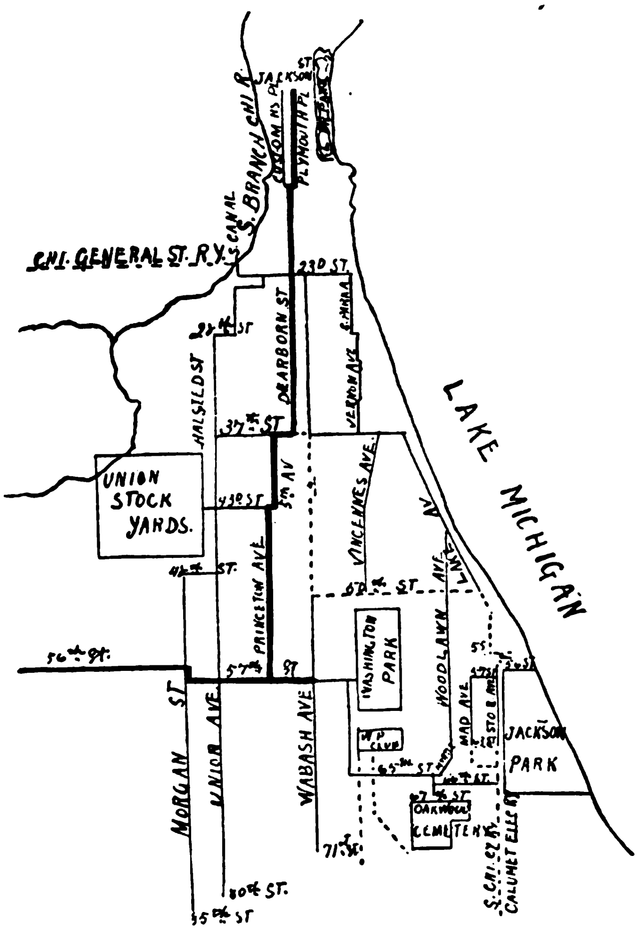
PLAN OF POWER STATION, ST. LOUIS & SUBURBAN RAILWAY, ST. LOUIS.

A LARGE CONDUIT RAILWAY SYSTEM FOR CHICAGO.

FOR some time past public attention in Chicago has been arrested on the plans of the local General Electric Railway Company, in which the Love Traction Company, owning the Love conduit railway system, is largely interested. It will be remembered that the Love open conduit was tried in Chicago once before, in a crude way, but that owing to faulty construction it was abandoned. After a lapse of four years, work is resumed, the General Company having secured franchises over a territory represented in the accompanying map, where the heavy lines indicate the proposed conduit system. The first line to be constructed by the company will have a downtown outlet at Jackson street. As indicated by the heavy lines in the diagram, it will follow Plymouth place to Fourteenth street, thence in Fourteenth to Dearborn, in Dearborn to Thirty-seventh, in Thirty-seventh to Fifth avenue, in Fifth avenue to Forty-third street, in Forty-third to Princeton avenue, in Princeton avenue to Fifty-seventh street, west in Fifty-seventh to Morgan, in Morgan to Fifty-sixth, and thence to Western avenue. A branch will also connect with Wabash avenue on Fifty-seventh street.

It is stated that bonds to the extent of $5,000,000 have been

underwritten by a New York banking house, and J. P. Morgan & Company have been named; but the statement is without confirmation up to date. Mr. Albert G. Wheeler, of the Love



Lines of the General Electric Railway, Chicago.

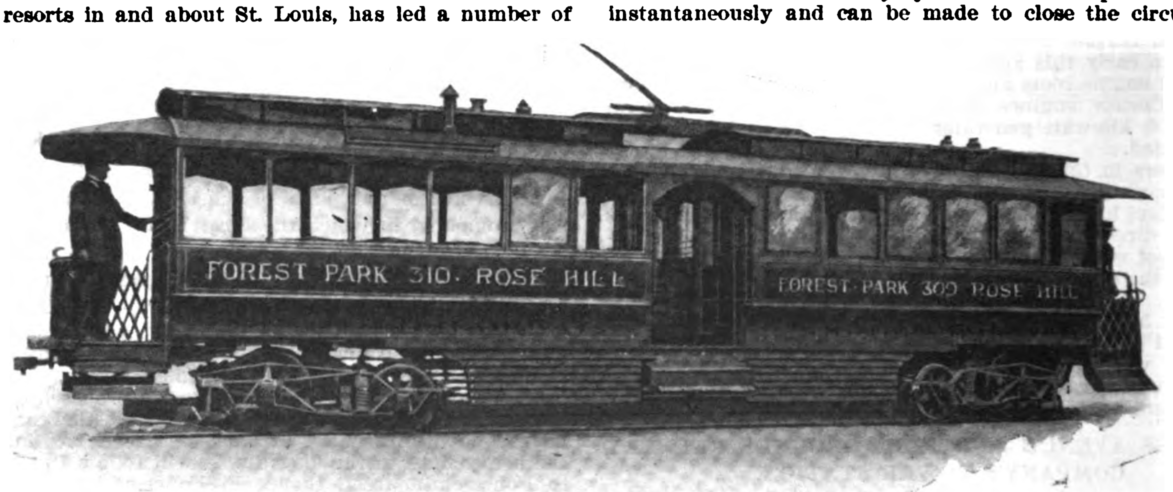
system, is one of the men most prominently connected with the enterprise.

DOUBLE TRUCK VESTIBULE CAR IN ST. LOUIS.

In keeping with the diversity of apparatus in the power stations of the electric railway companies of St. Louis is the variety of their rolling stock. The heavy night and morning traffic as well as that engendered by the numerous pleasure resorts in and about St. Louis, has led a number of the companies to the adoption of large cars. One of these is shown in the accompanying engraving.

This car is of the double truck vestibuled type, built up by splicing two 16-foot cars together. It has an entrance at the middle, thus expediting the time required for boarding and letting-off in busy hours.

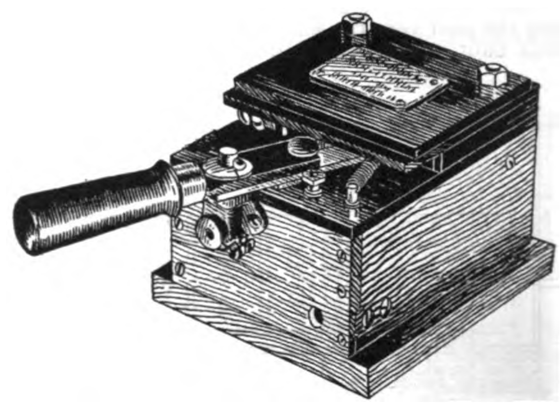
The seats in each compartment are placed longitudinally at the sides, and a short seat is also placed in the vestibule opposite the entrance. The car has a seating capacity for 53 persons, while when crowded 140 can be carried, the total standing room being 95 square feet.



Double Truck Vestibuled Car, St. Louis.

G. E. AUTOMATIC CIRCUIT BREAKERS FOR ELECTRIC CARS.

The motors and other appliances of street car equipments have hitherto depended for protection against injury from excessive currents on the common safety fuse in its box placed beneath the car platform and more or less inaccessible. The blowing of the fuse entails delay until the motorman replaces it, and as a certain time is taken by a safety fuse to blow, considerable injury may be done to the motors and



G. E. Automatic Railway Car Circuit Breaker.

other car apparatus in the interval in which it is reaching the melting point.

To avoid this delay the General Electric Company conceived the idea of making the main motor switch an automatic circuit breaker instantaneously operating and easily reset. This device has been perfected and the automatic circuit breaker for street railway car equipments, known as the "M" circuit breaker, is now being manufactured. In appearance it resembles the main motor switch and in every way answers the purpose of one. It is intended to be placed in the same position under the car hood. The handle is so arranged that the breaker may be opened and closed by hand in the same way as the standard main motor switch. The device is provided with magnetic blow-out and can thus break the severest short circuits without injury to itself. It opens the circuit instantaneously and can be made to close the circuit immediately after it has been opened, thereby avoiding delay to the car.

The "M" circuit breaker is so constructed that an automatic

counter may, when desired, be introduced into it, in such manner as to preclude any tampering with it by the motorman. This registers every time the circuit breaker opens automatically, and affords an excellent method of detecting the improper handling of the cars. It gives to the inspector a means of discovering those motormen who have turned on the current too suddenly, calling for an excessive amount of current.

The "M" circuit breaker is adjustable. By a simple movement of the calibrating spring the breaker may be adjusted to open at any predetermined amount of current within a certain range. The device is manufactured for 75—150 amperes and 150—250 amperes, the first figure representing the lowest tripping point, the second the maximum carrying capacity for steady loads. The adjustment may, however, be made to break the circuit at currents considerably higher than the maximum carrying capacity. This device will be exhibited at the St. Louis convention.

CONTACT SHOE AND BRAKE ON THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

At the time The Electrical Engineer published a description of the electrically operated railroad between Pemberton and East Weymouth on the Old Colony Division of the New York, New Haven and Hartford system, particulars regarding the method of braking and contact were not obtainable. We are now enabled to give these.

It will be remembered that on the line from Pemberton at the extreme end of Nantasket Beach to Nantasket Junction, a distance of 6.91 miles, the cars are operated by overhead trolley contact. From Nantasket Junction to East Weymouth

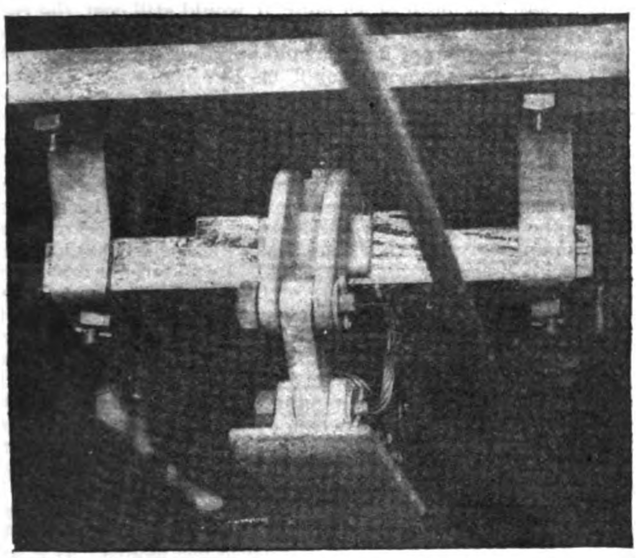


FIG. 1.—CONTACT SHOE, N. Y., N. H. & H. R. R.

the electricity is taken by means of the sliding contact shoes from a third rail laid in the center of each track. When the cars start from the Junction station, momentum is given to the car by electricity taken from the overhead wire and it is carried over to the third rail. The trolley then slips from the termination of the overhead wire, is pulled down and hooked and the shoes, one of which is illustrated in Fig. 1, come into contact with the surface rail. A knife switch under the hood of the car being closed, the current from the rail is thrown into the motors and the operation of the train is continued without interruption.

One shoe is placed between the axles of each truck, immediately under the king pin. It is suspended by two links, and thus hangs loosely. This allows it to slide over the surface of the third rail without difficulty and to make perfect and continuous contact. The distance between each of the shoes on a car is 33 feet; thus at crossings, where no third rail is laid, less than 30 feet wide, one shoe is always in contact with the end of one section or the beginning of the next; at wider crossings the impetus of the moving car brings the shoes into contact again before the car can come to rest. Each shoe is a cast iron plate twelve inches long and five inches wide. It weighs about 20 pounds and is connected to the motor by a flexible cable.

The air for the brakes is supplied by an electrically driven air compressor, Fig. 2, automatically controlled by the air pressure itself. The apparatus consists of a double vertical air pump with single acting cylinders, 5¾-in. x 7-in. stroke, directly connected to a series motor, the lower field of which

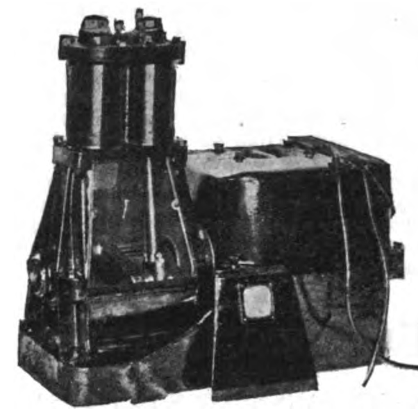


FIG. 2.—AIR COMPRESSOR ON ELECTRIC CAR OF N. Y., N. H. & H. R. R.

is extended to form the base of the air pump. The connection between the two is thus rendered very rigid. The capacity of the pump is 52½ cubic feet of free air per minute working against 90 pounds pressure per square inch. At this pressure the speed is 250 revolutions at 600 volts.

The air compressor is piped directly to the main reservoir, and is controlled automatically by a pneumatic governor consisting of a cylinder containing a piston working against a

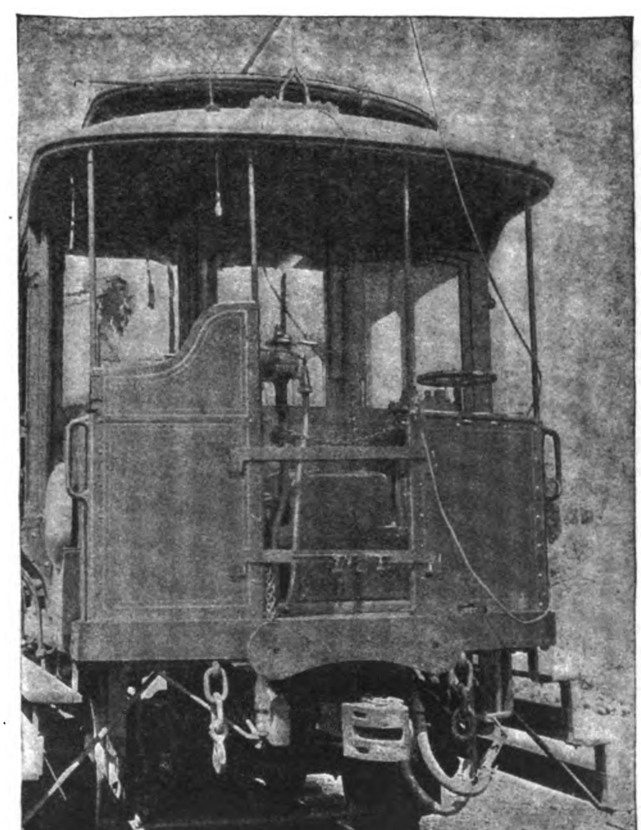


FIG. 3.—PLATFORM, ELECTRIC CAR, N. Y., N. H. & H. R. R.

spring. The action of this automatic control is as follows: The pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upward against the spring. The other end of the piston rod carries the contacts through which the pump motor circuit is made and broken. Any arcs that may be made when the

contact is broken are blown out in a magnetic field the coils of which are connected directly in series with the motor.

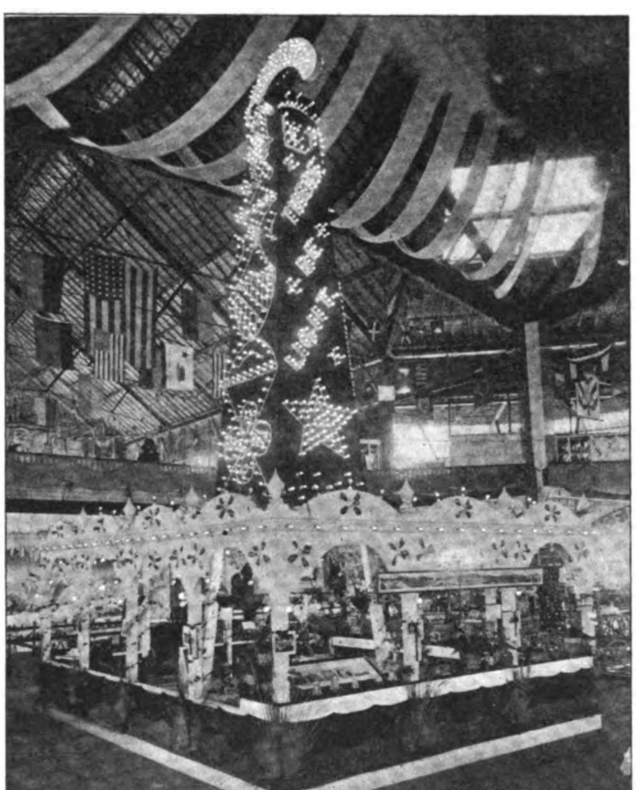
As the pressure in the reservoir falls from five to seven pounds, the piston is forced back into its normal position by the spring. The contacts are pushed down to their seat, the circuit is closed, current flows to the motor and the compressor starts. The circuit remains closed until the pressure reaches normal when it overcomes the force of the spring, forces the piston upward, separates the contact, breaks the circuit and the motor stops. This operation is repeated automatically, the combination of motor and pump requiring practically no attention. These automatic governors can be adjusted to any pressure from 45 to 100 pounds and work on a difference of from five to seven pounds in pressure.

The development of the combined air pump, motor and automatic governor is due to the General Electric Company. It is of recent design and takes the place of the oscillating cylinder type of air pump with which the motor cars were originally equipped.

ELECTRIC LIGHTING.

LONG DISTANCE TRANSMISSION TO THE SACRAMENTO STATE FAIR.

LAST month, at the successful State Fair at Sacramento, Cal., another interesting demonstration was given of long distance current transmission. The Sacramento Electric, Gas and Railway Co. made a fine exhibit in the shape of the beautiful tower, a cut of which is here presented. The height of this tower was 40 feet to the top of the sign, and the floor base was 20 by 25 feet. The number of lamps was 1,600, in six rows, which were flashed in seven combinations. The current was delivered to the tower from the Folsom three-phase circuits, the generating plant being twenty-two miles



TOWER AT SACRAMENTO FAIR, LIGHTED BY CURRENT FROM FOLSOM, 22 MILES AWAY.

away. The tower body was of black, studded with the lamps. On one side was the sentence "Let there be light," and on the opposite side were the names "Edison," "Thomson," "Franklin," and "Tesla." On the two remaining sides were arranged shields, scrolls, stars and other pleasing designs in colored lamps. Around the tower was a booth, the roof, pillars and counters of which were white. This also was tastefully decorated with lamps. The practical part of the exhibit in addition to this evidence of long distance work, consisted of an oven, boiler, tea kettle, chafing dish, curling iron, farina boiler, hot water urn, glue pot heater, laundry iron, tailor's iron, and four fans, all of which were operated by current from distant Folsom. The exhibit was in charge of Mr. J. H. Lawrence, under whose direction it was also set up.

CHARGING FOR ELECTRIC CURRENT ON THE WRIGHT DEMAND SYSTEM.—HOW TO ADJUST RATES SO THAT EVERY CLASS OF CUSTOMER SHALL BE PROFITABLE TO THE COMPANY.

BY R. S. HALE, E. E.

THE expenses of an electric company are of two kinds, of which the first consists of the outlay up to the moment of supplying the current, and the second of the actual expense while supplying the current. The expense of getting ready to supply current or the fixed expense consists of interest, dividends, part of the labor, all the management and legal expenses, etc., while the coal bill forms almost the only item of expense for actually running the machinery. Now if the price per kilowatt hour be 15 cents, and the customer burns his lamps one hour, the company gets 15 cents, of which 13 cents goes for management, dividends, etc., while the balance goes for coal, etc. If the customer burns his lamps a second hour it costs the company nothing more for management or interest or any of the fixed expenses, and if the company continued to charge 15 cents per kilowatt hour it would make a profit of 13 cents on a cost of 2 cents, or, roughly, 650 per cent. On the other hand, if the customer should burn his lights no more than one-tenth of an hour, it would still cost the company 13 cents for interest, etc., and though the coal, etc., for 1-10 hour, at 2 cents per hour, would only be 2-10 of a cent, the total cost to the company would be 13.2 cents per kilowatt, against 1½ cents per kilowatt income, or a loss of 88 per cent.

The following example will show the method by which any company may easily determine the amount of its fixed and running expenses, for it must be remembered that even part of the coal bill, namely, the cost of coal for keeping up pressure in the pipes and for banking fires, this coal being used whether the engines run for one hour or ten, is a fixed expense.

Let us suppose we have a company which sold 9,000 kilowatt hours in an average summer month, July, for example, and that the expenses, including 1-12 of the year's dividends, interest, etc., were $2,300. In December the expenses run up to $2,510, while the company sold about 16,000 kilowatt hours, or 7,000 kilowatt hours more than in June. The fixed expenses for management, dividends, etc., were, of course, no more in December than in June, so that the $210 extra expense in December was all running expense. As this extra expense of $210 was incurred in order to sell 7,000 more kilowatt hours, the extra cost was only $210÷7,000 kilowatt hours, or 3 cents per kilowatt hour. If no current at all had been supplied in June the company would then have saved only 9,000×3 cents=$270, and its expenses would have been $2,300 minus $270=$2,030, which would be the fixed expense per month. If it had supplied no current in December it would have saved 16,000×3=$480, and its fixed expenses would have been $2,510 minus $480=$2,030, or just the same as in June. A plant of this size would be prepared, after allowing sufficient reserve, to supply a maximum demand of about 500 kilowatt. The fixed expenses are then $2,030÷500=$4.06 per kilowatt of plant per month, or $48.72 per kilowatt of plant per year. The result is that if a customer uses 1-500th of the company's plant, in other words, if he burns lights equal to one kilowatt at one time he costs the company $48.72, even if he burns them only one hour in the year, while after that one hour in the year it costs the company only 3 cents per hour more for each hour he burns them.

The table given below shows the resulting cost per kilowatt hour for different fixed expenses and running expenses.

Now, in general, a company does not want to lose so much on one-half its customers that it must charge an exorbitant rate to the other half in order to come out even. Yet it is apparent from the above table that if a company charges 20 cents per kilowatt hour to all customers it loses from 80 cents to $1.80 on every thirty-hour per year customer, and makes from 11 to 18 cents on every ten-hour-a-day customer. Of course, in particular cases the company may charge more or less than enough for a fair profit, as, for instance, when it wants to secure a particularly influential customer, or to have a use for plant that would otherwise be idle, but these are obviously only temporary expedients, and it is apparent that

some system of charging is needed which will draw a profit from the short hour customers without making them feel that they are unfairly treated, and will give a low price to those customers who use their proportion of the plant long hours.

The Wright Demand System.—The Wright "demand system" is based on this principle. It does not interfere with giving an extra discount to the customer who has a very large bill, since one big customer needs less clerical force and is in general less bother than ten small customers. But the Wright system assumes that each customer should pay the fixed expenses, including dividends, etc., on the proportion of the plant that he uses, and in addition should pay running expenses only for the hours he actually uses the plant.

In order to accomplish this the watt hour or ampere hour meter is not sufficient, since the amount of plant required does not depend on the total number of kilowatt hours, but on the maximum current which is used at any one time. In order to show this and to show who are the long and short hour customers it is necessary to have in addition a demand meter to read the maximum current used by the customer at any one time during the year, for this is what determines the plant that must be installed at the central station in order to supply him.

COSTS PER K. W. HOUR.

Yearly fixed expense $60 per k. w. of plant or of demand.

Additional price per k. w. hour as per head of table.

Hours per day demand, if used.	Hours per business year.	—Price per k. w. hour for running expenses.— 3 cts.	5 cts.	7 cts.	1 ct.
		Total result per k. w. hour in cents.			
0	30	203	205	207	201
1	300	23	25	27	21
2	600	13	15	17	11
3	900	9⅔	11⅔	13⅔	7⅔
5	1,500	7	9	11	5
10	3,000	5	7	9	3
24	7,200	3⅚	5⅚	7⅚	1⅚

Yearly fixed expense $45 ditto.

0	30	153	155	157	151
1	300	18	20	22	16
2	600	10½	12½	14½	8½
3	900	8	10	12	6
5	1,500	6	8	10	4
10	3,000	4½	6½	8½	2½
24	7,200	3⅝	5⅝	7⅝	1⅝

Yearly fixed expense $30 ditto.

0	30	103	105	107	101
1	300	13	15	17	11
2	600	8	10	12	6
3	900	6⅓	8⅓	10⅓	4⅓
5	1,500	5	7	9	3
10	3,000	4	6	8	2
24	7,200	3 5/12	5 5/12	7 5/12	1 5/12

Methods of Charging.—The kilowatt hours used by the customer being known from the watt hour meter, and the maximum current used at once from the demand meter, the matter of arranging the charges may be done in several ways. The three following will be found to cover nearly every case.

The first method is to make a list price per kilowatt, and then give, say 10 per cent. discount, to the customer who averages two hours' use of his demand, 15 per cent. discount for three hours' use, and so on.

The second method is to charge 15 cents per kilowatt for the first two hours, and say 5 cents per kilowatt after this. We determine by the demand meter that a customer uses investment corresponding to 3 kilowatt, that being his maximum for the year, then 2 hours × 25 business days is 50 hours per month. His demand meter showed 3 kilowatt during the heavy load, hence he would be charged 15 cents per kilowatt hour up to 3×50=150 kilowatt hours in each month, and 5 cents per kilowatt hour for all kilowatt hours for over 150. This, as well as the discount system, has the disadvantage that the very short hour customer still uses as much plant as the moderate or long hour customer, and unless he should guarantee payment for one or two hours' use of his demand pays you practically nothing for its use.

The third method, which seems best adapted to American practice is to charge a fixed amount per year, payable in twelve equal installments, if desired, as rent for the investment. This is from $30 to $60 per kilowatt per year. Thus, if a customer's demand meter shows that some time during the previous year he used 4 kilowatt (80 lights), his charge for rent would be $240 per year, at $60 per kilowatt, or $20 a month. In addition, a charge of 3 or 4 cents per kilowatt hour would cover the running expenses. Under this scheme, although each customer's bill would be enough to cover his share of the fixed expenses as well as his share of the running expenses, no customer would show profit enough to warrant the company's giving him a lower price except under very unusual circumstances.

These methods may be modified in whole or in detail to suit the circumstances of each company, and the particular prices would be different for each company. Thus the running expenses per kilowatt will be far larger if coal is $5 a ton than if it is $1.50. See table of costs.

Special Advantages of the Wright System.—Every electric company has in its district many gas and oil users, who burn their lights long hours and cannot, therefore, afford to put in electricity at the present tariff. The Wright system gives a chance to offer to such a lower price at a good profit to the company. In addition it offers a lower price at a greater profit to the company to all customers who will use their lights longer hours, and that there are many such is well known to any one who will notice how many houses there are where oil or gas is still used in dark corners where a constant light is required. Under a tariff which makes a very low charge for long hours the advantages of appearance and health will make electricity preferable.

The Wright system will discourage no customers except those who do not pay their proportion of the fixed charges, and who are, in fact, a loss to the company. If desirable these customers may be retained under the old system, though it is usually better that they should be allowed to drop off, thus making room for really profitable customers.

The Wright Demand Meter.—The meter to be used needs special consideration. It must show the maximum current used, it must be accurate, it must be such that it cannot be tampered with by the customer, it must be slow acting, it must not show a short circuit that acts only for a second (there is no part of the investment that will not stand an overload of 100 per cent. for a minute or two), and, lastly, it must be impossible for it to get out of order, since the maximum that the meter records occurs only once in a year, and if the meter is out of order the opportunity is lost.

The Wright demand meter possesses all of these characteristics, and is simple as well as efficient. It consists of two sealed glass bulbs, connected by a U tube filled with colored liquid. The current passes through a coil wrapped around one bulb, the heat expands the air therein, and the air forces the liquid into the other bulb, out of which it is spilled into a closed tube. The greater the current the more liquid is forced up and spilled over. A scale is placed beside the closed tube and may be calibrated so that the height of the liquid spilled over shows the current in amperes or in kilowatts, or lamps, at a given voltage. The reading may be returned to zero by tipping up the glass tube and allowing the liquid to flow back. No allowance need be made for external temperature, since that affects the air in both bulbs equally. The instrument can be calibrated as accurately as desired. It is furnished in a strong iron case that can be locked or sealed against tampering. It cannot get out of order, since the only moving parts are the air and the liquid, and both are hermetically sealed in the glass bulbs and tubes. For the same reason it will never wear out. It will register slowly, approximately, 90 per cent. in 5 minutes, 95 per cent. in 10 minutes, 99 per cent. in 15 minutes, 100 per cent. in 30 minutes, thus being fair to the customer. It will always register 100 per cent., in which, as well as in its reliability and freedom from getting out of order, it has the advantage over any mechanical form.

In conclusion, it is enough to say that some twenty or thirty companies abroad are using the Wright system and have no idea of going back to any other, while hundreds of others are looking forward to adopting it. In fact, it may be said that thousands of companies, both in the United States and abroad, have practically adopted it, since the only reason for selling current for power cheaper than for light is that power customers are long-hour customers.

The first company to adopt this system was that at Brighton, in England, three years ago, and as a result of three years' use all of their 1,300 customers are thoroughly satisfied with the system and the company is to-day selling 50 per cent. more current in proportion to the plant used than it could on the ordinary system of charging. That means that without reducing expenses they can reduce the average price to about 75 per cent. of the former price, keep up the same rate of dividends, and have everything over the 75 per cent. as clear profit. There is no reason why every company in the United States should not make a similar gain.

THE

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CONTENTS.

ELECTRIC RAILWAY PROBLEMS.

It would be according small credit to the truly Herculean labors and energy of the large body of intelligent workers who have brought the electric railway art to its present condition, to assert that their efforts had gven us apparatus as far superior to that of ten years ago, as the modern bicycle is to the velocipede of fifty years ago. This is true as much of the electrical as of the mechanical constructions of electric car equipment; but with a full appreciation of what has been accomplished and the example furnished by the improvements of the past ten years, are we not warranted in looking for as great an advance at the end of the next decade? Even the most sanguine advocate of present methods would, we think, admit that improvement is not only possible, but desirable on lines which must be apparent to any one who has followed the course of events in this field.

Leaving out of consideration the minor improvements which time always brings with it, we would like to call attention to a few of the more important ones just at this time. It may be assuming a radical position to assert that gears and pinions must go, but we believe that that time is coming, and that it will be welcomed by all street railway managers. The cost of renewal of these parts of the present apparatus and the waste of power which their employment involves need not here be gone into, as it is a well known fact. That it has been realized is evidenced by the efforts which have already been made to bring about the substitution of other means of transmitting the power from motor to car axle without their intervention. We need only refer to the experiments made with hydraulic and similar devices, and also to the mounting of the motor armature directly on the car axle, but thus far none of these methods has made any perceptible headway in actual practice.

The suspension of the electric motor is another detail, which will bear additional study. For, in spite of the improved methods of this nature now employed, the fact remains that even with the heaviest rails employed the track shows the effects of pounding to an undue degree after but a comparatively short lapse of time. It would seem that some method were desirable for removing the weight of the motors from the car axles altogether, and its suspension from the truck frame entirely. This method has also been tried in a number of instances, but has not met with that success which the object to be attained calls for.

Perhaps many of the existing troubles experienced in trolley car operation, both mechanical and electrical, are traceable, if not entirely, at least in large part, to the continued use of two motors. In spite of the introduction of the multiple series controller the fact remains that the electrical efficiency of the motors is not commensurable with that which would be obtainable from a single motor operating under like conditions of change of load. It would lead us too far to enter into a discussion of the causes of the relative inefficiency of the two-motor arrangement and, indeed, they are too well known to need rehearsal at this late day. But, notwithstanding these unquestioned drawbacks, little has been done to introduce the obvious remedy. We believe that a one-motor equipment can be produced which will do all and more than the present two-motor, and that its advent will be hailed with delight by all railway companies now struggling to keep their rolling stock in running condition. We might continue in this strain and point out the desirability of being able to reverse suddenly without breaking anything, the need of mechanical brakes, and like advantages in other parts of the apparatus, but enough has been said, we think, to show that the individual or company that will bring about these and other improvements will not have to wait long for reward.

MYSTEROUS BREAKDOWNS IN INSULATION.

FROM the very beginning of electric lighting as an established industry the item of repairs has cut no inconsiderable figure in the accounts of central station and isolated plant operation. Later on with the introduction of the electric railway this factor in the operating expenses has in numerous cases swallowed up a good deal of the profits. Repairs of a mechanical nature will always be called for in machinery subjected to the hard usage that electrical machinery has always experienced, and due allowance must be made for the great ignorance still, unfortunately, existing and far too common among those placed in charge of electrical apparatus. But it is not to the mechanical repairs that we would here direct attention, but rather to the electrical, which, in spite of the vastly improved methods of construction employed, call annually for enormous amounts in the aggregate.

The weak spot still existing in electrical machinery is the insulation, and this refers as much to that of armatures and field magnets of generators and motors as it does to conductors, transformers and the like. It may be fairly assumed that competition among manufacturers has led to the employment of the best means of insulation known to the art, and hence the mishaps which still cause so much annoyance may be traced not so much to faulty or inferior construction as to other sources not usually considered, but which it is believed will have to be seriously looked after in the future. One of these causes can, we think, be directly traced to the present method of handling electric currents at the switchboard. The universal practice in the handling of electric currents is to effect the interruption or break in the shortest time in order to avoid destructive arcing, and the nearer this time has approached to instantaniety the more perfect the operation is considered to be. Where the currents to be handled are small this may not lead to any serious trouble, but it can readily be seen that where large currents are involved, such as is the daily practice in many electric light and railway stations, an element of danger is introduced which may in time cause serious trouble in the generating apparatus as well as in the conductors.

In the admirable paper on "Alternate Current Transformers," by Dr. J. A. Fleming, which was recently concluded in our columns, attention was drawn to this point more particularly in relation to its bearing and effect upon concentric alternating cables. Dr. Fleming showed that if a long cable of this character having considerable electrostatic capacity had the current suddenly "jumped" on it or interrupted, resonance effects might, under certain conditions, cause such a rise of potential as to pierce the insulation. One of the remedies for this particular case is to introduce some device into the circuit which will prevent the sudden rise of potential due to this cause.

We think that the warning sounded by Dr. Fleming is to a large extent also applicable to apparatus operating with direct current. It is hardly conceivable that generators or motors delivering currents of several hundred or even thousands of amperes can have their circuits interrupted without in time suffering from the strain put upon their insulation by the high induced electromotive force accompanying the interruption. It is true that it might be a difficult matter to trace the exact cause of failure in conductors or apparatus to this particular phenomenon, but that many of them are traceable to it is highly probable. The remedy for the evil is obvious. If, instead of breaking the circuit instantaneously, it could be effected gradually, though not necessarily occupying a space of time exceeding a second, the object would be accomplished. Such a method of circuit control would probably prevent the numerous "mysterious" failures of cables and puncturing of armature and field insulation which have begun to be looked upon as the work of kobolds, or as due to the inherent cussedness of electrical apparatus. Of course the means and apparatus required for such a method of breaking and making a circuit must not be too bulky or expensive for general application, and we know of no better field for exercise of inventive genius than the designing of such an arrangement.

TELEGRAPHIC STAGNATION.

THE annual report of the Western Union Telegraph Co., which is printed elsewhere in our columns, is a very interesting document to all electrical workers, and particularly to those directly engaged in the transmission of intelligence by wire. A great many inferences may be drawn from the statistics presented, but that which goes more directly to the vital point would teach us the cessation of growth in the telegraphic industry. Do the facts support the theory that any further expansion of the telegraph on a large scale is impossible? Does the telegraph in its growth fail to keep pace with the growth in wealth and population, and if so, why?

Turning to the figures, it is seen that although the number of messages declined in 1894 to 58,632,237, a falling off of about eight millions in one year, there has literally been no recovery since that time. This might be put down to the deep depression in business, but as the telephone has meanwhile been gaining enormously in use, the inference must be that to some extent the telephone has overlapped the telegraph, and, to use a yachting phrase, is persistently "blanketing" it. There is now barely one telegraph message annually per head of population. The number of telephone messages has reached about eleven per head. And even in crediting one per head for telegraphs, we have to add twelve millions at least to the Western Union figures as representing the share of the Postal Telegraph Company. It might be twice as much without materially affecting the comparison.

When it comes to carrying capacity, it will be admitted by all who know the facts that physically the Western Union system is well handled and is in a much better condition than when it was doing its great business of nearly 200,000 messages daily. But although rates have come down, operating expenses have not greatly yielded. Revenue per message is now, broadly stated, around 30 cents, where once it was nearly 40, but the cost per message fluctuates around 25 cents through a long period, and is now, after sharp retrenchment and vigilant economy, about 24 cents.

What can be done to rehabilitate the telegraph as the popular means of swift communication? It has been said that as there is no renewal of the old Western Union-American Bell agreement, the telephone lines will carry telegrams, and vice versa. In such an event the telegraph service would probably show up very advantageously, but we hardly look for that kind of warfare between the two great systems. What we do look for, and what we feel positively convinced must come, is a means of sending letter-telegrams, by machine methods, at a cheap rate, cutting into the incalculable field of mail matter between cities and accelerating correspondence by hours and days. But even that contingency is likely to be faced by other managers of the Western Union than those who have brought it through the late ordeal of business panic and industrial depression with the conservative prudence demanded more than any other quality by the situation.

THE ELECTRIC LIGHTING OUTLOOK.

ONE of the most extraordinary documents submitted lately to the attention of the electric lighting public is the annual report of the Anglo-Brush Co. (Brush Electrical Engineering Co., Ltd.), which coolly accounts for a poor year by intimating that there is no more electric light business to be had. The actual language is: "The directors regret that the profits of the year are not larger. The result is attributable partly to a general falling off in the volume of central station electricity supply contracts. . . . The directors anticipate, however, that the future demand for electrical traction plant will fully compensate for the shrinkage of orders for electric lighting machinery."

This is simply awful, and cannot be too sharply or strongly reprehended. The mere suggestion that England has all the electric lighting it wants or will ever get is so preposterous that even to mention the idea must provoke scorn and ridicule. To-day the electric lighting in England is still an insignificant fraction of the actual and possible illumination. The art has but begun its career, invention is young, the public interest has only recently been seriously aroused, and the numerous good qualities of the light are utterly unknown to the bulk of the nation. Even in America, where the adoption of the electric light has been far more general, it is universally felt that its adoption has but been inaugurated. We could not name a local company that has not plans of extension to be carried out when financial conditions are improved by the certainty of sound money, while new stations are being built all the time.

If the Anglo-Brush Co. is so soon tired and sees no future for electric lighting it had better clear out and make way for men of longer foresight and higher faith in their own products. As for the future of traction, whatever that may be in England, here at least it is certain that the needs for lighting apparatus will far outrun those for street railways. The railway companies are already supplying the public fairly well, while there is not a local lighting company to-day that could meet one-twentieth of the demand possible on it for electric light and power, and we say possible, because everybody prefers electricity to other agencies for the purpose. We are glad to know there is so good an outlook now for electric traction in England. It is certainly high time. But as to lighting, our advice to the Anglo-Brush people is to cheer up and hustle.

TELEPHONY AND TELEGRAPHY.

CHANGES IN THE NEW YORK TELEPHONE SYSTEM.

ONE reads a good deal in certain quarters about the movement of business uptown in New York. But the movement uptown is a trifle in comparison with the upward movement downtown. As a matter of fact business people seem to prefer to move up in the air, maintaining communication with the groundlings by means of express elevators, than to move out of the historic and natural downtown business district to the more airy part of the city where buildings are content with a modest eight or twelve stories. The large number of cloud-soaring office buildings which have shot up during the last few years below Chambers street, has materially increased the office capacity of the downtown district. This growth of business population has been accompanied by a rapid increase in the use of telephone service, and the advent of new subscribers has lately come within measurable distance of overtaking the capacity of the famous 5,100 line switchboard at Cortlandt street.

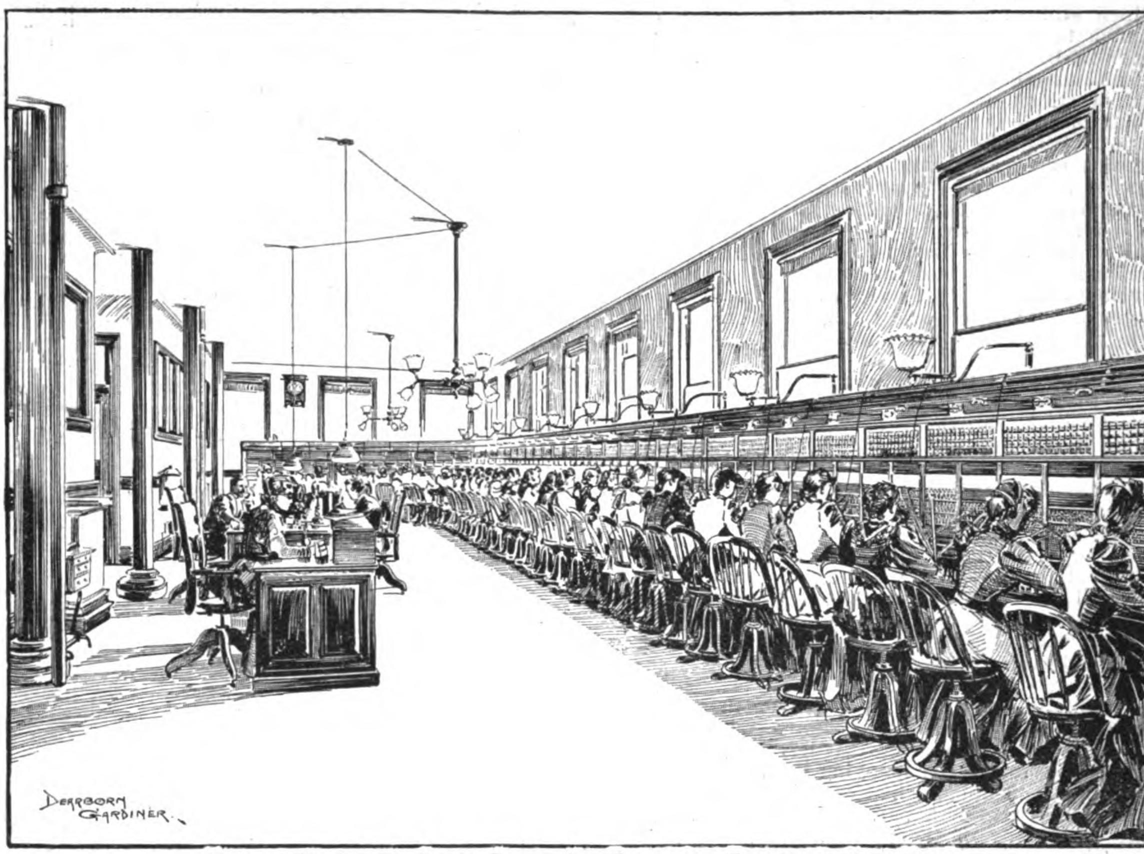
When this switchboard was first installed, some eight years ago, it took the place of four small exchanges, whose names are now but a memory, and served the whole of the downtown district south of a line drawn along Desbrosses street, Hudson street to Worth street, Worth to Division, Division to Rutgers, and Rutgers street to the East River (see Map 1.)

The general plan under which the New York telephone system has been rebuilt provided for two other downtown exchanges, the district of one—Broad street—to be taken entirely out of the Cortlandt street district and that of the other—Franklin street—to be taken partially out of the Cortlandt district and partly out of that of Spring street, which was formerly the next exchange north of Cortlandt.

The Broad street exchange was opened the first day of January, 1894. At that time about 4,000 subscribers were connected to the Cortlandt street switchboard. The new district comprised all the territory bounded by the east side of Broadway and Whitehall street to the Battery, and the south side of Wall street to the East River. (See Map 2.) This territory contained 1,050 subscribers' lines, which on the 31st day of December, 1893, were operated from Cortlandt street, and on the following day began to be operated from the new exchange at Broad street. This large removal gave Cortlandt a good breathing spell, the number of subscribers being reduced to about two-thirds the total capacity of the board. A still further reduction was made when the Franklin street exchange was opened a few months later, cutting off another slice of Cortlandt territory, and annexing some 350 Cortlandt subscribers.

Since these changes were made the message rate system of charging for telephone service came into play, and under its benign influence the increase of subscribers has gone on for the past two years at a greatly accelerated rate. So much so, that early in the spring of this year the number of lines operated at Cortlandt street was again considerably over 4,000, and progressing steadily upward.

In view of the growing density of the telephonic population of the Cortlandt street district and of the impracticability of increasing the capacity of the Cortlandt exchange except by building a new switchboard, a work not to be lightly undertaken in the present state of the switchboard art and in the present state of the Cortlandt street building, it was necessary to find an outlet for the stream of subscribers bent on carrying the largest New York exchange by assault. This was done with ease, if at considerable expense, by turning part of the Cortlandt street district into Broad street; in other words, by enlarging the Broad street district, and diminishing that of Cortlandt. The western boundary of the Broad street district has been extended from Broadway to the North River, and all the territory between those two lines and south of Exchange Alley and Morris street now belongs, telephonically speaking, to the Broad street exchange, instead of, as formerly, to Cortlandt. (See Map 3.) This takes some 250 subscribers out of the Cortlandt board and, of course, all new subscribers in the transferred district will be connected to the Broad street exchange.



VIEW OF OPERATING ROOM, BROAD ST. TELEPHONE EXCHANGE, NEW YORK.

The Broad street exchange was equipped with a bridging switchboard, designed for an ultimate capacity of 3,000 lines. The equipment actually completed at the time of opening provided for a total of 1,500 subscribers' lines, allowing for an increase of nearly 50 per cent. in subscribers over the number contained in the original district. During the two years and a half that the exchange has been in operation, the number of subscribers has increased from 1,050 to 1,350, so that in order to provide for the large addition of lines entailed by the transfer, it was necessary to increase the equipment of the switchboard. This has been done without adding new sections to the switchboard by means of converting two com-

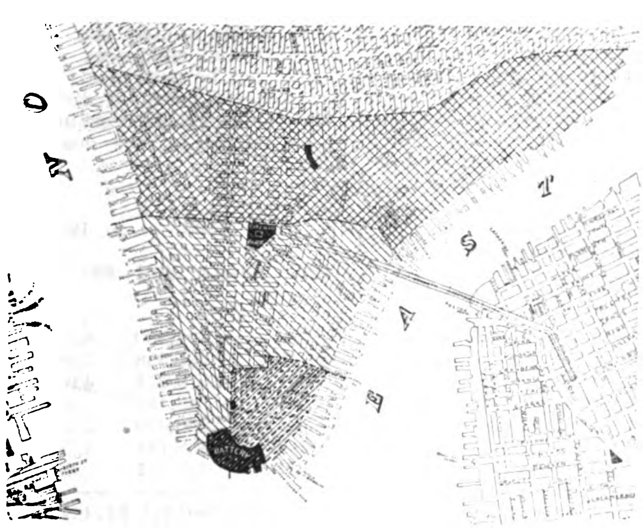
mon trunk sections into subscriber sections and by adding to the equipment of all the original subscriber sections.

The switchboard originally consisted of three incoming trunk sections with capacity for 270 incoming trunk lines, ten subscriber sections with 150 line drops and answering jacks, and three common trunk sections originally used for miscellaneous trunks and lines to the commercial exchanges. These latter

MAP 1.—ORIGINAL CORTLANDT ST. DISTRICT.

are now operated as regular subscriber lines, and the common trunks are consolidated at one section. The two common trunk sections thus left free have been converted into fully equipped subscriber sections of 195 drops each and 45 drops have been added to each of the original subscriber sections. This arrangement gives a board of twelve subscriber sections of 195 lines each. The total capacity of the board is now 2,340 subscribers' lines, being an increase of 840 lines over the original equipment.

The addition of the 840 drops and answering jacks was by no means all the work required to extend the capacity of the board. It goes without saying that to the original quota of 1,500 multiple jacks in each of the sixteen sections, 840 more had to be added. Further, the outgoing trunk equipment had to be increased by the addition of 120 outgoing trunk jacks to each subscriber section, keyboard apparatus to be added to certain sections and the capacity of the distributing board and protector plant to be enlarged. The work of fitting the



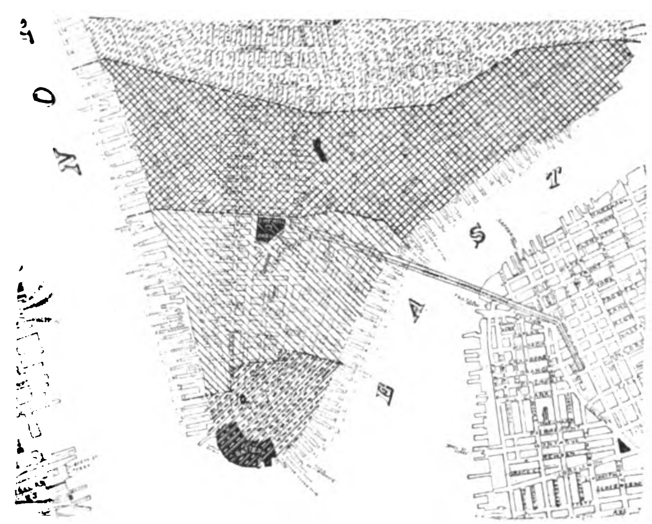
MAP 2.—FRANKLIN, CORTLANDT AND BROAD ST. DISTRICTS.

new apparatus, which included over 16,000 spring jacks, 780 self restoring drops, some 15,000 feet of cable and wire of different kinds and 840 sets of protectors and distributing board terminals, was carried out in accordance with the specifications of the engineer to the New York Telephone Company by the Western Electric Company, the builders of the switchboard.

So much for the inside work. But a large transfer of subscribers from one district to another involves a neat little problem in underground distribution and rearrangement of lines. This sort of arrangement has been met and coped with successfully several times before in the course of rebuilding the New York telephone system, and the Engineering Department of the New York Telephone Company, under the able direction of Mr. J. J. Carty, has become expert in solving it in any and all phases in which it may present itself. In the present instance the work has been much facilitated by the rapid progress made during the past year or two in the system of direct block distribution, devised by the company's engineer and carried out by the Construction Department. Under this system the main cables run out from the exchanges are designated feeder cables. From the points where these feeder cables terminate the distribution is carried out by means of distributing cables diminishing in size as the various subscribers' stations are supplied. It is scarcely necessary to point out that this method bears a strong family resemblance to distribution for electric lighting.

To serve the ten blocks comprised in the addition to the Broad street exchange four feeder cables, three of 100 pairs of conductors and one of 150 pairs, were laid from the Broad street exchange to different points for connection with the block distributing systems. These cables contain a total of 724,400 feet of twisted pair conductor. They afford provision for the 250 subscribers transferred, and for an increase of 200 subscribers in the district.

The transfer of subscribers from one exchange to another is effected by connecting all the lines to be transferred to the new feeder cables at the distributing points, the original lines being still left through to the old exchange. The lines in the



MAP 3.—FRANKLIN, CORTLANDT AND BROAD ST. DISTRICTS, SHOWING RECENT ENLARGEMENT OF BROAD AND DIMINUTION OF CORTLANDT.

new feeder cable are connected to their respective drops and answering jacks at the exchange end. Thus each subscriber is still working to his original exchange while there is bridged on to his line a completely equipped line to the new exchange. During the night appointed for the transfer the lines are put out of service at the old exchange and the connection is completed and the service taken up at the new. Thus, during Wednesday, September 30, some 250 subscribers were calling on Cortlandt for connections, and on Thursday morning, October 1, their calls were answered at Broad street. This change was effected without a hitch of any sort. It is much like changing from one completely furnished house to another equally thoroughly equipped and in running order, without the trouble of packing, moving and settling down,—an improvement in the ordeal of household affairs that every housekeeper would appreciate.

Writing of the Broad street telephone exchange calls to mind that in the beginning of its existence it was the scene of an interesting reception offered by the company to the subscribers whose lines were operated from the exchange. A special invitation was sent to each subscriber to attend a private view of the building and its electrical equipment, where the working of the exchange end of their telephone service might be advantageously inspected. A large number of Broad street subscribers attended the reception, and examined the apparatus, and watched the manœvres of the operators with undisguised interest and surprise. It was

evident that most of the visitors were quite unprepared to find that the equipment of a telephone exchange contained so much elaborate and highly finished apparatus, and that the work of answering calls and making connections required the unremitting attention of a numerous and well organized staff. Very many false impressions were corrected by that short visit to headquarters, and without exception the visitors departed with revised and improved opinions on telephone service.

The great improvement in the New York telephone service that has been brought about during recent years is due to several causes, which might all be summed up under the head of good management. To obtain good telephone service there are three requisites—a good plant, a well trained staff and intelligent co-operation on the part of the subscribers. The last can do wonders. New York is well off in all respects. The telephone plant of New York City is, to use a nautical phrase, well-found throughout. For completeness, for substantial, enduring material it is not equalled, scarcely approached by any large telephone system in the world.

Complete metallic circuit working, with long distance transmitters at every station are found nowhere but in New York. The staff of the New York Telephone Company has practically grown up with the system, and knows its work root and branch; there is scarcely any responsible officer of the company, from the president down, but has assisted in the complete rebuilding of the system, and has trained those under his direction to working under the new conditions and to the careful handling and operation of the new material. No staff could have better training. Lastly, much has been done toward the educating of the subscriber. By means both of the distribution of printed matter and by personal interviews the correct manner of handling the telephone and the few fundamental rules and practices of operating have been impressed on the subscriber in general. As a result the New York telephone service gives small ground for complaint; it is rapid, the talking is good, and interruptions are rare. Some complaint there must always be. It is not in human nature, nor in the nature of inanimate objects, that some 17,000 persons should co-operate through the medium of a vastly complicated system of wires and apparatus during every busy hour of every busy day without giving rise to a certain amount of friction. That the friction is as slight as it actually is, is vastly to the credit of the wires and apparatus and of the 17,000 co-operatives—subscribers and telephonists.

TELEPHOTIC PROBLEMS.—I.

BY EDWARD WAGEMAN.

IT is the prevalent opinion that with the transmission of light rays accomplished, the problem of telephoty has been solved. This is far from being the case. It gives us only a stepping stone upon which to build further facts. The combined light rays of the spectrum, constituting white light rays, are transmitted already, but the object appears only in white and dark outlines, and at its best as yet very unsatisfactorily. When experimenting with the transmission of colored light rays reflected from an object, the first difficulty encountered is the very fact that not the original light rays emitted from the source of light are available for transmission; the objects possess a certain unknown selective power with regard to certain different rays comprising the spectrum. The objects absorb some rays, others are refracted, and a certain number only are reflected to the transmitter, which selects some of the spectral rays and absorbs the same, transforming them into electrical impulses which form on the receiver the outlines of the object, as stated above. But what becomes of the rays from the colored surface of the object, and why are they not reproduced?

It appears that the element which is in chemical combination with the selenium will not respond to particular different wave lengths of the spectrum, but that it transmits and reproduces only the combined rays of the spectrum, and it is a question whether the effects appearing on the receiver are not due to the infra red end of the spectrum alone. It is evident that another element is needed in chemical combination with the selenium, which is either capable of instantaneously disintegrating the light rays transmitted by the other element in the proper places on the surfaces of the object in the receiver, or responding in the receiver as well as in the transmitter to distinct wave lengths of the spectrum, and must be instantaneous in its action. It will be seen that the possibility is disregarded of telephoty being feasible in some mirrorlike action.

The selection of this other third element will necessitate many hundred carefully executed experiments as the necessary data regarding the qualities demanded are wanting or incomplete, and must be made in daylight as well as with every known and employed source of illumination, as it is well known that the indices of absorption, reflection and reproduction will change with every source of illumination, and one must be selected of nearly uniform index in all kinds of illumination.

FIGURES FROM THE WESTERN UNION ANNUAL REPORT.

THE annual report of the Western Union Telegraph Company for the fiscal year ended June 30 shows gross earnings of $22,612,736, the largest gross since 1893, but net earnings of only $5,897,980, a decrease of $243,409 from the net of last year. This showing is partially explained by the table of comparative costs per message, which shows that during the year the average cost reached 24 cents, or more than any year since 1885; while a similar table shows that the average tolls per message were only 30.9 cents, a rate than which only three years in the company's history have been lower. The following table from the report shows comparisons in detail:

	Miles of wire.	Messages (000 omitted).	Receipts.	Profits.
1885	462,283	42,096	$17,706,833	$5,700,924
1886	489,607	43,289	16,298,638	3,919,855
1887	524,641	47,394	17,191,909	4,037,281
1888	616,248	51,463	19,711,164	5,070,571
1889	647,697	54,108	20,783,194	6,218,041
1890	678,997	55,878	22,387,028	7,312,725
1891	715,591	59,148	23,034,326	6,605,584
1892	739,105	62,387	23,706,404	7,398,547
1893	769,201	66,591	24,978,442	7,496,037
1894	790,792	58,632	21,852,655	5,792,484
1895	802,651	58,307	22,218,019	6,141,389
1896	826,929	58,760	22,612,736	5,897,980

President Eckert says in part:

"The table shows an increase of 453,129 messages. But by an analysis of our reports we find that we transmitted and delivered about 920,000 more full-paid messages than we transmitted and delivered during the year ended June 30, 1895. The difference between these two sums is accounted for by a decrease in the number of press, government, signal, and sundry other messages. The decrease in the number of press messages arose from the great depression of business and from the transfer of service to wires newly leased from us, thereby taking it out of the count of messages handled by our employés.

"The increase in operating and general expenses was caused partly by the necessary expenses for establishing the additional 365 offices that were opened in various localities during the year, and partly by the outlay for operators and messengers' salaries and for incidental expenses in handling and delivering the increased number of full-paid messages shown above.

"The increase in the cost of maintenance and reconstruction of lines was caused by an unusual number of destructive storms, especially the cyclone at St. Louis, and by work that, with a proper regard for the stability and efficiencey of the lines upon which it was done, could not be postponed."

At the meeting of stockholders, the old board of directors was re-elected, and Roswell G. Holston and E. H. Perkins, jr., were chosen to fill the vacancies caused by the death of Austin Corbin and George Bliss.

The balance sheet is as follows:

Assets.

	1896.	1895.	1894.
Lines, leases, franchises, patents, etc.	$101,306,875	$100,572,331	$99,431,566
Stocks and bonds in exchange for coll. tr. bonds	8,401,000	8,397,500	8,353,750
Other securities	7,516,231	7,295,558	7,296,679
Real estate	4,979,534	4,979,534	4,979,534
Supplies and material	126,264	243,483	340,122
Accts. rec'vable, etc.	2,593,572	2,560,610	2,283,572
Cash	1,388,081	1,488,434	1,768,266
Sinking funds	461,693	428,721	412,387
Total	$126,723,250	$125,966,171	$124,865,876

Liabilities.

	1896.	1895.	1894.
Capital stock	$95,370,000	$95,370,000	$94,820,000
Fund'd debt	15,275,208	15,280,928	15,261,134
Gold & St'k leases	2,039,200	2,039,200	2,039,200
Accounts payable	4,796,965	4,230,383	4,139,725
Sur. prior to Oct. 1, 1881	1,598,184	1,598,184	1,598,184
Other surp's	7,643,694	7,447,476	7,007,634
Total	$126,723,250	$125,966,171	$124,865,876

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—V.

BY LIEUT. B. A. FISKE, U. S. N.

THE STEERING TELEGRAPH.

THE office of this instrument is to telegraph from certain places in a ship to the steering wheels, the position at which it is desired to put the helm. This is accomplished by means of certain apparatus, called transmitters, placed where desired and electrically connected to indicators secured in conspicuous positions near the steering wheels. The principle on which the system depends is the same as that on which the helm indicator depends, the transmitters consisting of strips of resistance wire, through which currents of electricity are passing and over which traveling contacts are moved by an operator, while the indicators are galvanometers connected electrically to these contacts.

Fig. 7 is a diagram of electrical connections for a steering telegraph system, comprising three transmitters, shown on the upper part of the page, and two indicators shown on the lower part of the page.

The resistance wires, a a', are traversed by currents of electricity, furnished by any suitable source, such as a storage battery, primary battery, dynamotor, etc.; in Fig. 7 the source is the electric light mains of the ship, a suitable resistance being interposed, as shown, to reduce the current in each transmitter to about 2 amperes. The passage of a current of electricity through the resistance wire of any transmitter, such as the second transmitter shown in Fig. 7, is immediately due to a difference in electric pressure, or potential, between different parts of the wire; so that the permanent metallic contact, G, and the traveling contact, C, are at different pressures or potentials. If the current is flowing in the direction represented by the arrow-heads, contact, C, is at a higher potential than G, so that a current of electricity will pass through any galvanometer connected to them, going in the direction from C to G, and move the galvanometer needle to the left. If, on the other hand, C were to the right of G, it would be at a lower potential and the current through a galvanometer connected to C and G would go in the direction from G to C and move the galvanometer needle to the right. If the contact, C, were at the middle part of the wire and rested on G, C and G would be at the same potential and the galvanometer needle would remain at rest in the middle of the scale.

In order that two or more transmitters may be connected independently, and yet be so adapted that any one transmitter may be used at any time, the contact, C, and the wire, G, are so arranged that the contact, C, does not touch the wire when it is in its middle position. So long, therefore, as the contact, C, of any transmitter is in its middle position, that transmitter is not connected to a galvanometer and does not affect any galvanometer or any other of the transmitters. In the position shown in Fig. 7, the movements of contact, C, of the second transmitter affect the galvanomters just as though the first and third transmitters were absent. When not in use, the contact of each transmitter should be placed in its middle position, not touching the resistance wire. This caution is marked on each transmitter case. The amount of the movement of contact, C, may be shown on a graduated scale and the resistance in the circuit so adjusted and the galvanometers so marked that the galvanometer needles will point to the figure that indicates the movement of the contact, C. This method is like that adopted in the helm indicator, but a preferred method is that shown in Fig. 7, because the system is not affected by any changes of electro-motive force of the generator, and the work of adjusting the resistance is avoided. By the plan shown in Fig. 7, there is placed in front of each transmitter a galvanometer exactly similar to the galvanometers which act as idicators at the steering wheels. The operator, then, at any transmitter, moves his contact until the galvanometer in front of him points to the desired helm position—say, 20 degrees port; and the two indicators at the steering wheels will instantly show 20 degrees port.

A further advantage of the use of this galvanometer at the transmitter is that the operator always knows by its movements whether or not the apparatus is working.

In the absolute apparatus, as ordinarily constructed, the resistance wire, a a' is wound in a spiral groove on the circumference of a cylinder, D, of insulating material, such as rubber, as indicated in Fig. 8. The two ends of the wire are connected to flat springs, a a', against which press the ends of the binding posts, A, B. The permanent contact, G, is connected by a short pin to a metallic ring, R, placed at one end of the cylinder; and a flat spring, P, connected to the binding post, E, continuously presses on the ring, R. At the point where the permanent contact, G, is connected to the wire, the groove in the cylinder is cut down deep into the cylinder, so that the contact, C, cannot touch it. To accomplish this, in constructing the apparatus, the cylinder, D, is cut in half transversely, and the contact, G, after being soldered to the

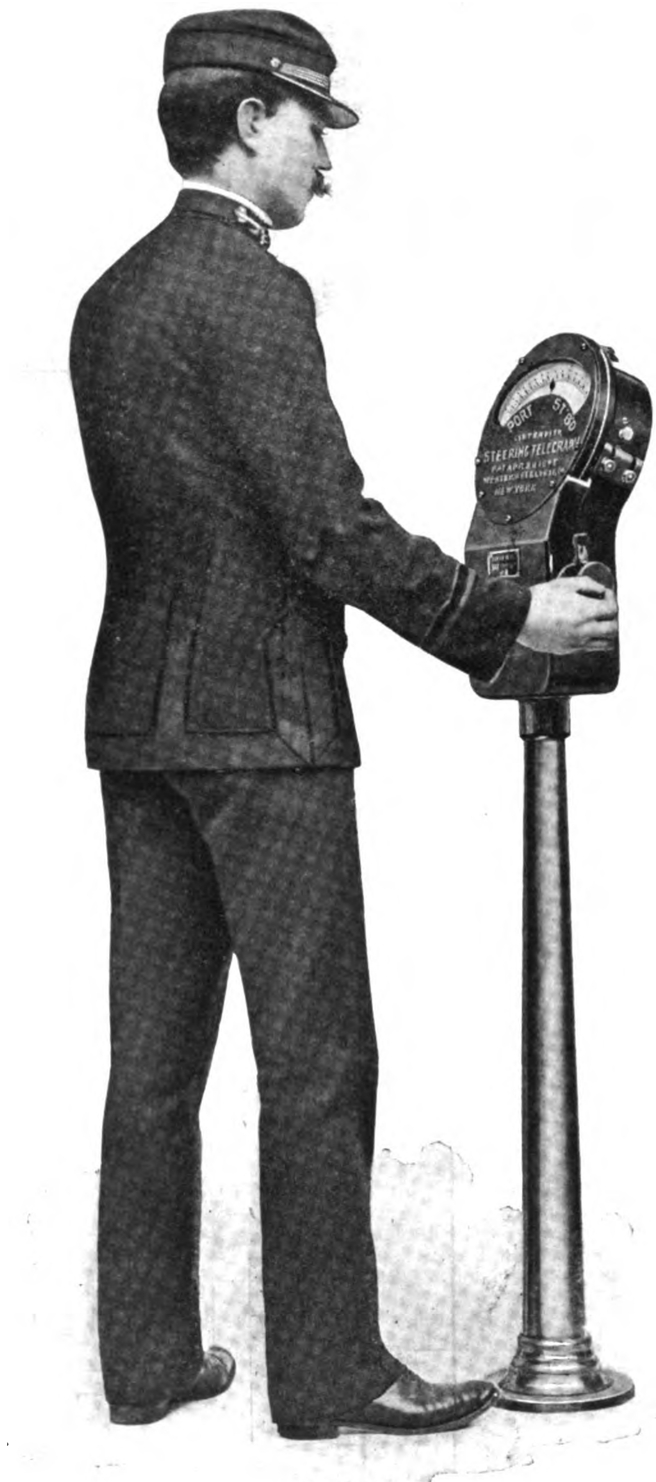


FIG. 8A.—ELECTRIC STEERING TELEGRAPH.

wire which is to be wound on the cylinder, is secured in position. Then the two halves of the cylinder are screwed together and the wire is wound in the groove. To produce movement of the contact, C, it is mounted on the nut, N, which travels on the screw, S, C being insulated from N. The pitch of the screw, S, and of the spiral thread in the cylinder, D, are the same, so that, as S is revolved by turning the handle, H (thereby turning D by means of the gear wheels shown), the nut, N, is moved along the screw, S, and the contact, C,

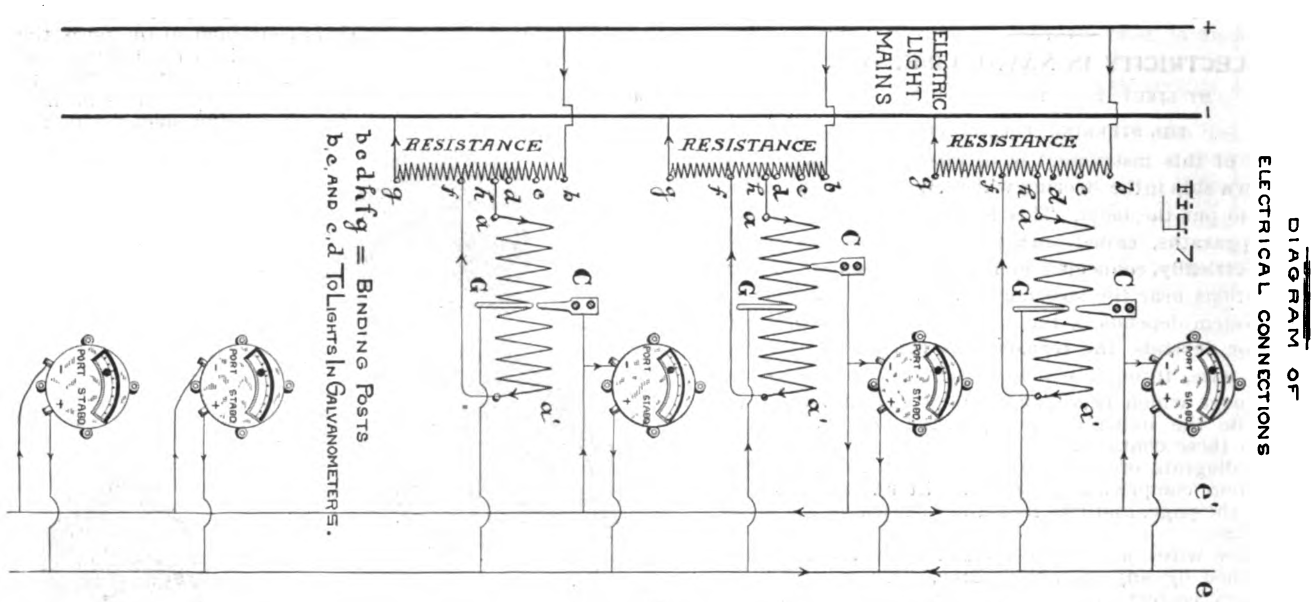

STEERING TELEGRAPH
DIAGRAM OF
ELECTRICAL CONNECTIONS
Fig. 7.
ELECTRIC
LIGHT
MAINS
RESISTANCE
RESISTANCE
RESISTANCE
b c d h f g = Binding Posts
b, c, and c, d To Lights In Galvanometers.
PORT
STARD

Fig. 7.

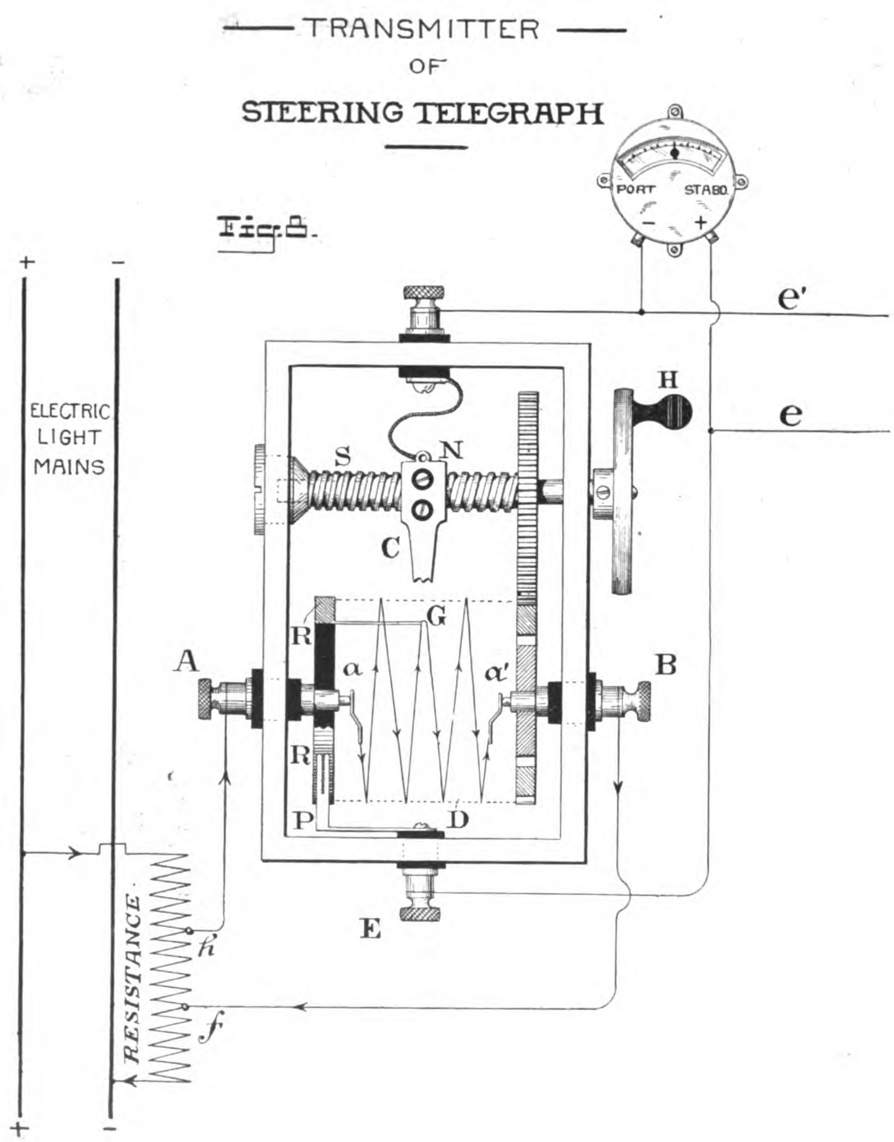

TRANSMITTER
OF
STEERING TELEGRAPH
Fig. 8.
PORT
STARD
ELECTRIC
LIGHT
MAINS
RESISTANCE

Fig. 8.

along the wire, a a', the contact always remaining in the groove that holds the wire.

The copper wires connecting the instruments should not be less in size than No. 16 American gauge.

The transmitters of the steering telegraph are so arranged that any transmitter can be used independently of any of the others and produce the corresponding deflections in all the galvanometers, both of the transmitters and receivers, so long as both of the other transmitters are secured carefully at zero; but any movement of any transmitter while another is in use is indicated immediately by the erratic movements of all the galvanometers. In order to show clearly when a transmitter is at zero, a glass is placed in its face through which the sliding contact can be seen. When the transmitter is at zero the reference mark on the sliding contact is directly in line with the zero mark in the transmitter; and it can be secured in this position by means of a stout pawl which falls into a slot cut in the handle, H, Fig. 8.

The steering telegraph was given a year's test in sea service on board the U. S. S. New York, and the test having passed successfully, the apparatus has since been installed in the U. S. battleships Indiana and Massachusetts, using in each ship three transmitters and two indicators. It is now being installed in the Texas, and is to be installed in the Brooklyn.

Weight of indicator, 22 pounds.
Resistance of indicator, 60 ohms.
Weight of transmitter box, 6 pounds.
Diameter of indicator, 10 inches.

UTILIZATION OF CULM.[1]

BY N. W. PERRY.

As illustrating the relative economies of gaseous and electrical transmissions, the late Mr. Denny Lane, an English gas engineer of prominence, once stated that, with ordinary 16 candle-power gas, 3,000 horse-power could be sent a distance of one mile for an expenditure of 1 horse-power—an economy of distribution far exceeding that possessed by any other system, being only 0.03 per cent. of the power conveyed.

With respect to the cost of mains, he says, taking the cost of conductors laid on the low-pressure culvert system at £5,500 per mile for the conveyance of 1,080 amperes, and assuming an electromotive force of 110 volts, the power would be 158 horse-power. It would, therefore, require, he says, two pairs of these conductors to convey 300 horse-power, while a 6-inch main, with ordinary gas, would convey sufficient gas for that power at 4-inch pressure, and at 16-inch pressure would deliver as much as four pairs of such conductors. The 6-inch main, he says further, would cost £500 per mile, while two pairs of low-pressure conductors would cost £11,000, and four pairs would involve an expenditure of £22,000 per mile.

The lecturer has found, by calculation, that to transmit this power to the distance named, at 220 volts, the metal in the pipes would cost considerably less than the metal in the conductors. Contrast this with electrical transmission, in which 10 per cent., or 300 horse-power would be an allowable loss, and we see how the gas transmission has the advantage over the electrical.

I also find that a 6-inch pipe will deliver 6,000 cubic feet of illuminating gas per hour at a distance of 10,500 feet, under 4 inches of water pressure. If this be 16 horse-power gas, and be used in a gas engine, allowing 25 cubic feet per horse-power hour, this quantity represents 240 horse-power.

Cast-iron pipe, 6 inches in diameter, having a thickness of ½ inch, weighs 31.9 lbs. per foot. The total weight of this two miles (nearly) of pipe will, therefore, be 334,950 lbs. This would be equivalent in conductivity to about 41,869 lbs. of copper equally distributed over the same distance. But four miles of copper, weighing 41,869 lbs., would be equivalent to about four No. 000 B. and S. wires, which would have a resistance for the four miles of 0.325 ohm. If the charging current was transmitted at 220 volts there would be required a current of 848 amperes; but a wire having a resistance of .325 ohm will only deliver under a pressure of 220 volts, $220 \div .325 = 677$ amperes; there would, therefore, be required five No. 000 B. & S. wires to deliver this energy, and the weight of this would be 53,540 lbs.

If the distribution took place at 1,000 volts, the amperes required would be approximately 180. To deliver this at the same distance with a loss of 10 per cent. would require 6,264 lbs. of copper, and to deliver it at 1 per cent. loss would require 62,642 lbs., which would cost far more than the pipe, and still give less efficient transmission.

When the fuel is delivered in this form it is adaptable to all of the uses to which fuel is ever applied. It can be burned under boilers for the raising of steam for power or heat purposes, or it can be applied to domestic uses, or it may be used directly to advantage in gas engines. In no case need there be any stand-by losses, such as are inevitable with solid fuels, for when the fires are wanted it is only necessary to turn on the gas, and when they are no longer needed it may be turned off, and there are no ashes or coal to be handled.

For power purposes a somewhat extensive investigation of the question has satisfied me that, if we can procure cheap gaseous fuel, the gas engine is the proper thing to use, especially in situations such as are found in our electric lighting stations and elsewhere, where the load is variable between wide limits.

In such situations a portion of the boiler plant must lie idle during the hours of light load, and it has been estimated by very competent authorities that the consumption of coal of the idle boiler amounts to 10 per cent. of the total consumption of all the boilers.

With the gas generator the stand-by losses are so small as to be negligible in comparison, so that a direct gain in economy is here attained.

I believe that all of the English gas-engine manufacturers will guarantee their engines, even in comparatively small sizes, to produce a brake-horse-power-hour, when using Dowson gas, on 1¼ lbs. of anthracite coal or less. It is seldom that our largest compound condensing steam engines are found to give equally good results.

In view of these facts there are many who believe that the problem of utilizing the culm accumulations is to be solved by the conversion of this culm into cheap fuel gas at the banks, and its transmission thence in pipes to the point of consumption, or to the centers of distribution by other more convenient means.

I believe, although I have not attacked this problem from the numerical side, that it would be economical to pipe this artificial gas to Philadelphia from the nearer coal fields. I know, however, that it would be more economical for your electric lighting and power companies to convert their fuel into gas on the water front, and distribute it thence in pipes to gas engines favorably located as to distribution, than to cart their coal to these centers, pay rent or interest on the investments required for boiler and coal storage room, and other attendant expenses.

[1] Abstract of a lecture delivered before the Franklin Institute.

RULE FOR ESTIMATING THE POWER FACTOR IN THE COST OF CARBIDE OF CALCIUM.

BY LIEUT. F. JARVIS PATTEN.

If we assume an output of carbide of four-tenths pound per horse-power at furnace terminals, about 6 per cent. more than shown in the Spray tests, and assume steam power at New York to cost $45 per horse-power year of 6,000 hours, then steam will cost three-quarters of a cent per horse-power hour. It would, therefore, require 2,000 or 5,000 horse-power hours to make one ton of carbide. Adding 20 per cent. for unavoidable losses, this would be 6,000=600 horse-power continuously operative to produce one ton of carbide in ten hours. This at three-quarter cent per horse-power is 4,500 cents, or $45, would be the cost of power required to make one ton, which would be the assumed price of one horse-power per year above. Therefore, under these assumptions, the cost of power for producing one ton of carbide is the same as the price of one horse-power per year.

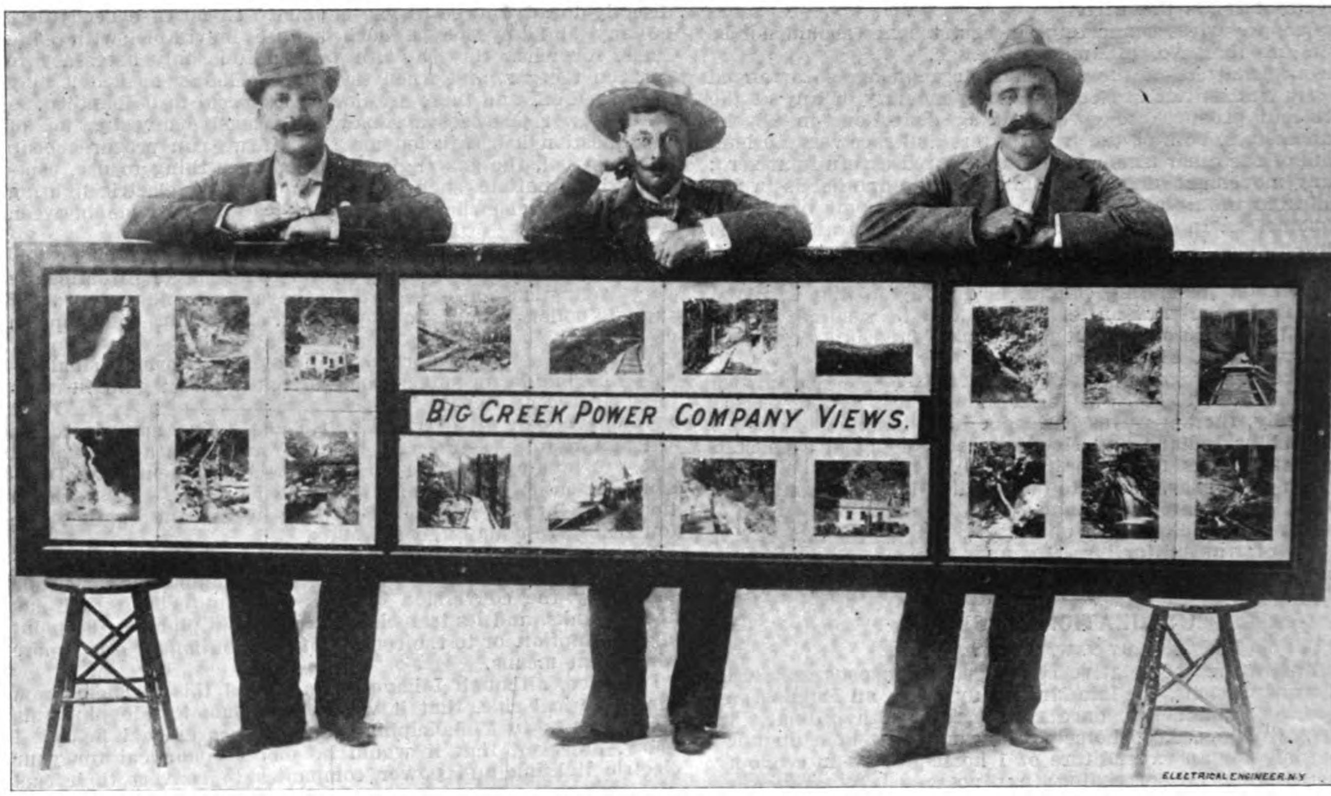
So, if water power costs $5 per horse-power per year, then the power factor in the cost of carbide is $5 per ton.

To find the actual cost of carbide we have to add the cost of lime and coke and labor; excluding the labor factor we may proceed as follows: It takes 0.875 ton of lime and 0.5625 ton of coke to produce a ton of carbide, hence the rule: Multiply the cost of lime per ton in dollars by 0.875, and the cost of coke per ton in dollars by 0.56 and add to their sum the cost of horse-power per year in dollars; the sum is the cost of a ton of carbide exclusive of labor, interest, depreciation, etc.

Example: Coke = $2.75 a ton.
Lime = $2.50 a ton.
1 horse-power = $5 per year

then $(0.875 \times 2.50) + (0.56 \times 2.75) + 5.00 = \$9.72$.

Another simple calculation based upon the same assumption of 0.4 pound per horse-power hour indicates a ready answer to the question, how many tons of carbide can be produced daily with a given steam or water power? The answer is that since the rate is 0.4 pound per horse-power hour, it is also one ton per horse-power year of 6,000 working hours. Hence the rule, any power as 5,000 horse-power continuously operative should produce 5,000 tons of carbide a year. These rather remarkable coincidences of figures offer, therefore, a ready rule of thumb system of calculation and remain true until new discoveries or improvements shall operate to reduce the power factor which is, of course, the principal one.—"Progressive Age."



VIEWS OF POWER HOUSE AND FLUME, BIG CREEK POWER CO., SANTA CRUZ, CALIFORNIA.

POWER TRANSMISSION.

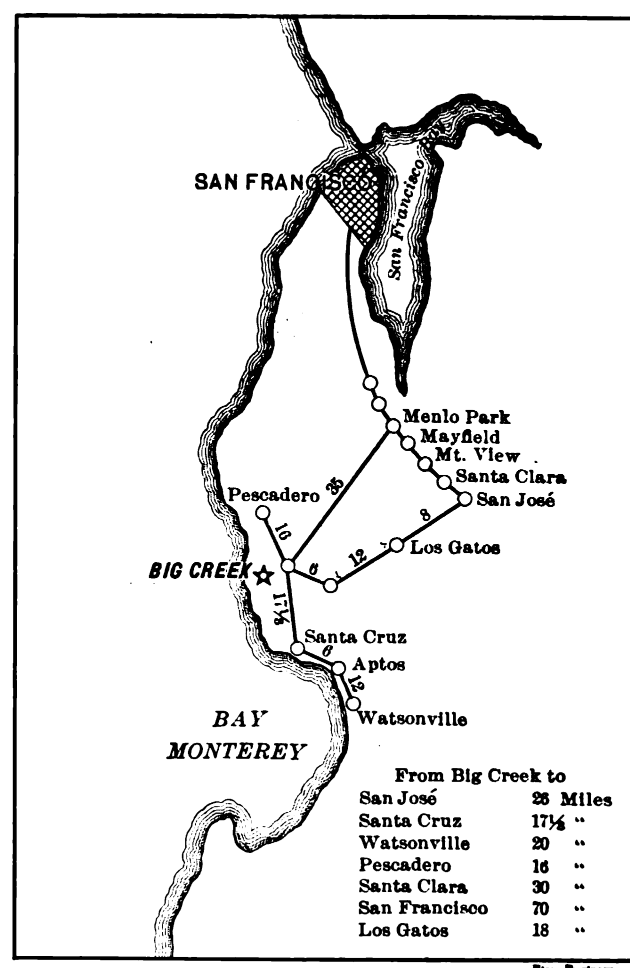
THE BIG CREEK, CAL., POWER TRANSMISSION.

IN the year 1889 Santa Cruz, Cal., saw the completion of its first incandescent light station. This work was the result of the labors of Mr. F. W. Swanton, who, with the success of the electric light plant assured, next proceeded to the organizing and building of the Santa Cruz Electric Railroad. The power for the railroad was furnished from the electric light station. During a period of six years the fuel bill for the combined electric light and railway power station rose to the enormous figure of $60,000, owing to the high price of coal in that region, and hence came the desire for a cheaper source of power than could be produced by steam. Mr. Swanton did not have far to look, and soon had secured possession of Big Creek from its mouth to the top of the mountain, thus securing control of the best water power in the country and the one having the greatest fall.

The minimum power available from this creek under existing conditions is 500 h. p., but a site has already been secured for an impounding reservoir which will increase the minimum capacity to 1,000 h. p. all the year round. At present the creek has an available capacity of 2,500 h. p. for eight months in the year.

The plant works under a head of 923 feet, to obtain which was constructed a wooden flume, 11,125 feet long and having a depth of 18 inches and a width of 30 inches. The flume was built of one-inch redwood boards doubled with lapped joints. From the penstock the water is carried for 1,930 feet of leaded and banded joint pipe of the following dimensions, beginning with the penstock and continuing towards the power house: 965 feet of 16-inch No. 12 iron pipe; 370 feet of 14-inch No. 10 steel pipe; 200 feet of 14-inch No. 8 steel pipe; 200 feet of 14-inch No. 6 steel pipe; 200 feet of 14-inch No. 5 steel pipe.

The power house is a small temporary wooden structure, containing at present a 46-inch Pelton wheel having a capacity of 500 h. p. at 600 revolutions per minute. The wheel is designed to operate one 150 kilowatt generator on each side. At present but one such generator has been installed, and this is a Westinghouse two-phase machine, operating at 1,100 volts. From the switchboard the 1,100 volt current is conveyed to two 75 kilowatt self-cooling transformers, by means of which the potential is raised for transmission purposes to



MAP SHOWING BIG CREEK, CAL., AND SURROUNDING TERRITORY.

from 10,000 to 11,000 volts, according to load, and at the same time transformed into 3-phase current by the Scott system. Round redwood poles are used on the transmission line. These poles are thirty feet long, are set approximately forty to the mile, and each carries two cross arms, the top one being a four-pin and the lower a two-pin arm, thus providing for two 3-phase circuits.

The wires consist of No. 5 B. & S. gauge bare copper wire, which are transposed at every pole. Immediately below the lower cross arm is carried the telephone circuit, which is strung on brackets and transposed every fifth pole, and conversation is carried on between the power house and the substation, a distance of seventeen and one-third miles, with ease.

The sub-station, which is located on the ground floor of the Pilot Building, in Santa Cruz, contains transformer and switchboard equipments practically identical with those at the power house, and in addition the switchboard carries panels of four two-wire distributing circuits of from 1,000 to 1,100 volts.

The entire output of the Big Creek Power Company is at present sold in bulk to the Santa Cruz Electric Light and Power Company. The Big Creek Power Company has recently placed an order with the Westinghouse company for the duplication of the plant above described, which will give a total of 400 h. p. in generator capacity at the power station. These two 2-phase generators are to operate in parallel supplying current to a common circuit, and the generators are to be coupled direct to the water wheel by means of specially constructed friction clutches.

The accompanying map shows that the company are in a situation to command a large field for power. They expect eventually to operate the railway system, and also the city lighting and pumping plant, and also motors for manufacturing and other purposes.

The reproduction of a photograph, which appears on page 402, gives a number of views showing construction of the pipe line, power house and other details of construction. The three gentlemen leaning on the frame were the most prominently active in the carrying out of the work. Mr. F. L. Robinson, who appears on the left, is the president of the company; the gentleman in the center is Mr. F. W. Swanton, to whom is due the inception of the scheme, the location of the water power and the financiering of the enterprise; and at the right is Mr. C. E. Lilly, the electrical engineer.

As regards the financial outlook for the company, it may be of interest to note that it started off by paying 18 per cent. on its investment with its first contract.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.—III.

(Concluded.)

BY DR. LOUIS DUNCAN.

POSSIBLE VOLTAGES AND DISTANCES OF TRANSMISSION.

A number of calculations have been made as to the possibility of transmitting electrical energy to very long distances. If the question of cost of transmission alone is considered, then where water powers or culm heaps are within distances of 100 miles of some large center of consumption, it has been shown that it would be profitable to generate and transmit electrical energy. In these calculations, however, voltages are assumed that have never been employed for commercial plants, and whose availability is problematic, while sufficient stress is not apparently laid on the question of the reliability of the power. If the industries of a large city depended upon a single transmission plant, it is evident that the question of reliability is of paramount importance. Where energy is supplied to manufacturers, to street car systems, and for lighting, a break down that would involve the cutting off of current for a day would mean an enormous pecuniary loss to the community. As the distance of transmission increases, the possibility of accident is increased in greater ratio because we have not only the higher voltage to control but the length of the line that must be looked out for is also increased. The best guide lies in the practical experience which has been obtained in the present transmission plants and the consideration of the difficulties that have arisen and the remedies that have been employed. I have prepared a partial list of the principal transmission plants that are now in operation.

It will be seen that the longest transmission is at Fresno, Cal., the distance being about 35 miles. The highest alternating voltage used is 13,000 volts at Zurich, Switzerland. The highest direct potential is 15,000 volts at Brescia.

All of these plants are working successfully, and this fact will lead to still longer transmission and higher voltages. No limit of either distance or potential has as yet been reached. If we consider the record of the present transmission plants, we can safely say that it would not be going outside of the safe limit of development to transmit at least 50 miles at a potential of 20,000 volts, provided the energy could be delivered at such a price as to be considerably lower than the cost of a corresponding amount of energy obtained from a steam plant. This, of course, is a matter of local condition entirely, and the commercial value of such a transmission will depend upon local conditions.

LONG DISTANCE TRANSMISSION FOR RAILROAD WORK.

The possibility of long distance electric railroad lines is intimately connected with the possibility of long distance transmission of power. We have seen that it is possible to transmit considerable distances from a single station. The current so distributed is not, however, such that it can be applied directly to railroad motors, but it must be transformed at points along the line, the distance apart of these points of distribution depending upon the system that is employed. At present continuous current motors are used and considerations of safety would lead us to use line potentials not greater than 700 volts. By distributing rotary transformers at distances of five or six miles apart, we would be able to supply motors with current without any great investment in copper. The amount of copper required could be still further reduced by using rotary transformers with storage batteries, thus keeping a constant load on the transmission line. It will be found, however, that on any long distance railroad line, the load on any section of the line is exceedingly variable and the discharge rate of the batteries will have to be very high in order to prevent excessive cost for our reducing stations. It is doubtful whether we have reached a point in battery construction that this system of transmission would be economical. It is certain, however, that when the distances are comparatively short, say within 15 miles, and where the traffic is not evenly distributed, that rotary transformers, with or without batteries, can be economically employed for railroad work.

Name.	Type.	Distance in miles.	Line voltage.	Horse power.	Remarks.
Ouray, Col.	Direct.	4	800	1,200	Successful, increasing.
Geneva, Switzerl'nd	"	20	6,600	400	Successful.
San Francisco, Cal.	"	12	8,000	1,000	Successful, 9 years
Brescia	"	12	15,000	700	
Pomona & San Bernardino	Single ph. alt.	13½ to 28¾	1,000	800	Successful, inc., 4 years.
Telluride, Col.	"	3	3,000	400	To be inc., 3,200 H. P.
Bodie, Col.	"	12½	3,400	160	Successful.
Rome, Italy	"	18	6,000	2,000	Increasing to 9,000 H. P., 3 years.
Davos, Switzerland	"	2	3,660	600	Successful.
Schongeisung, Germany	"	4½	2,600	820	"
Springfield, Mass.	2-phase alt.	6½	3,600	820	"
Quebec, Canada	"	8	5,000	2,130	"
Anderson, S. C.	"	8	5,500	200	"
Fitchburg, Mass.	"	2¼	2,150	400	"
Winooski, Vt.	3-phase.	2½	2,500	150	"
Baltic, Conn.	"	5	2,500	700	"
St. Hyacinthe, Can.	"	5	2,500	600	" 2 years.
Concord, N. H.	"	4	2,500	5,000	" 2 years.
Fresno, Cal.	"	35	11,000	1,400	to be increased.
Big Cottonwood to Salt Lake City, Utah	"	14	10,000	1,400	Successful.
Lowell, Mass.	"	6 to 15	5,500	480	"
Sacramento-Folsom, Cal.	"	24	10,000	4,000	1 year.
Redlands, Cal.	"	7½	2,500	700	3 years, extending lines in other towns.
Lauffen to Frankfort, Germany	"	100	30,000	300	(Experimental).
Lauffen to Heilbronn, Germany	"	9	5,000	60	Successful.
Oerlikon Works, Zürich, Switzl'nd.	"	15½	13,000	450	"
Portland, Ore.	"	12	6,000	5,000	"
Silverton Mine, Col.	"	4	2,500	400	" to be inc.

CONCLUSIONS.

My conclusions, subject always to the influence of local conditions, are as follows:

1. In both direct current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station situated at the most economical point for producing power.

2. In the case of the traction systems, when the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of ten or twelve miles from a station, and beyond this rotary

transformers, whether with or without batteries, should be used.

3. In the case of direct current lighting systems, the energy should be transmitted to storage batteries situated at centers of consumption either directly or by means of a rotary transformers and distributed from them.

4. Where batteries are used it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.

5. The best system for the long distance transmission of energy, for general purposes, is the three-phase alternating system.

6. Commercial transmissions are in successful operation for distances of 35 miles, and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission to 50 miles with a pressure of 20,000 volts is practicable, beyond these limits the transmission would be more or less experimental.

Roentgen Rays.

THOMSON X-RAY INDUCTORIUM AND DOUBLE-FOCUS TUBE.

IMMEDIATELY upon the first announcement of Prof. Röntgen's experiments, Prof. Elihu Thomson took up the subject with his characteristic energy, and soon succeeded in developing a type of apparatus specially adapted for carrying on X-ray experiments. The results of his experiments

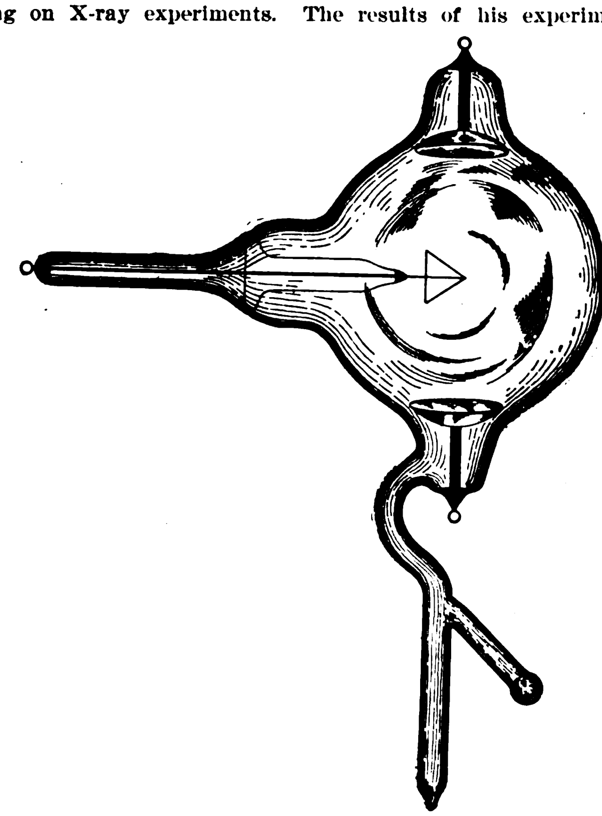


Fig. 3.—Thomson Double Focus X-Ray Tube.

have now been made available to the public in the X-ray apparatus manufactured by the Edison Decorative and Miniature Lamp Department of the General Electric Co., at Harrison, N. J.

Our engraving Fig. 1 shows one form of the Thomson inductorium capable of giving a constant stream of 6-inch sparks. In addition to the thorough insulation of the coil itself, the highest practical degree of insulation is obtained by placing the coil in a box filled with oil, Fig. 2. The contact breaker which goes with the inductorium is a rotary one, operated by a small motor, and is so constructed that the break occurs under water, so as to reduce the sparking unavoidable with the breaking in air.

A similar type of apparatus is made to give a 12-inch spark.

Prof. Thomson has also designed a Röntgen ray transformer, adapted to be run from alternating circuits. It consists of a low frequency and a high frequency transformer together with a condenser. On account of its high frequency and its practically unlimited supply, it makes a very powerful exciting apparatus.

Fig. 3 represents the Thomson universal double focus tube, which has been largely introduced in this country, as well as abroad. The two cathode electrodes are cup-shaped, and made of aluminum. The other electrode is a wedge-shaped

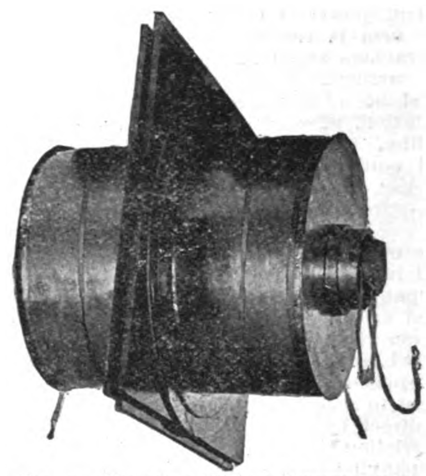


Fig. 1.—Thomson X-Ray Inductorium.

piece of platinum upon which the rays are focused. The sharpness of definition obtained by this form of tube is well known. The failing of the tube, owing to the increase of the evauum, has been provided against by the attachment of a

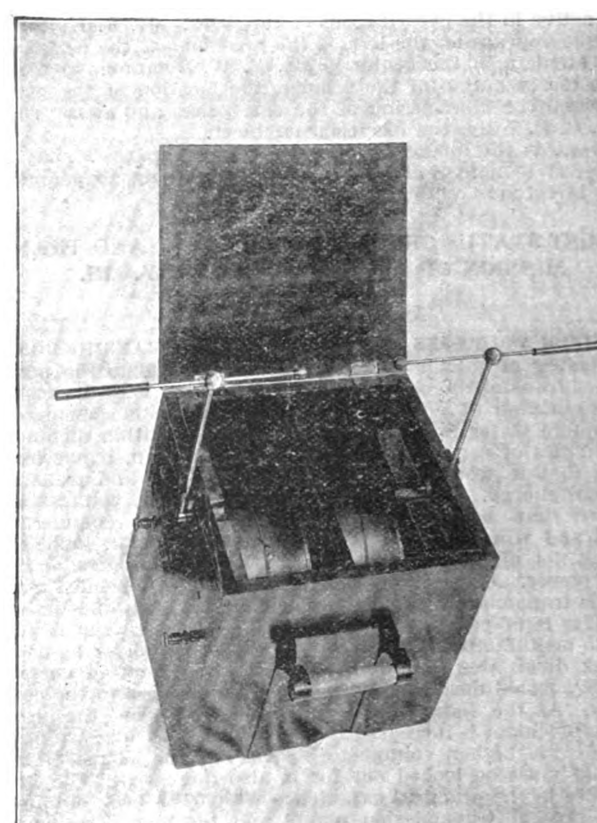


Fig. 2.—Thomson X-Ray Inductorium.

small auxiliary tube containing a chemical mixture. When the later is heated it gives off a vapor, which on entering the main tube brings down the vacuum to the proper point.

Another adjunct to an X-ray set is a diaphragm for shielding, which cuts of all stray rays and permits only those emanating from the platinum electrode to reach the fluorescent screen or photographic plate. In this way perfect sharpness of image is secured.

ROENTGEN RAYS AT THE BRITISH ASSOCIATION MEETING.

WE print below abstracts of a number of papers devoted to the Röntgen ray, read before the recent meeting of the British Association, at Liverpool.

Prof. Lenard read a paper on "Cathode Rays." After briefly sketching an outline of his well-known researches, he passed on to a statement of his views of the nature of cathode and Röntgen rays. Here he came into collision with the views of English physicists who were present, and thereby kindled the fire of an interesting but rather one-sided debate. All the English physicists who took part—Sir George Stokes, Prof. Fitzgerald and Prof. J. J. Thomson—stated unqualifiedly views opposed to those advanced by Lenard.

In a speech, lasting over one hour, Sir George Stokes gave an historical and critical account of the controversy. In the first place, he observed that although the cathode rays fell upon one side of an aluminum window, and were diffused from the other side, it did not necessarily follow that they actually passed through the thickness of the aluminum. He conceived that the action which was transmitted through the metal in such a case was not in the nature of a cathode ray, but bore to the cathode ray a relation which was analogous to the relation which the passage of ions of copper in an electrolytic copper salt bore to the dissolution and deposition of metallic copper at the anode and cathode. He believed the cathode ray to be a thing quite distinct in its nature from the Röntgen ray, and the confusion between them which had arisen from the similarity or identity of some of their properties he considered to have been brought about by the difficulty in completely separating the two classes of radiation. The cathode ray he regarded as a stream of electrified material particles, while the Röntgen ray he believed to be ethereal.

The next paper was one by Prof. J. J. Thomson and E. Rutherford, dealing with "The Laws of Conduction of Electricity Through Gases Exposed to Röntgen Rays." This dealt with the continuation of the researches on the effect of Röntgen rays upon the conductivity of matter, and the surprising result has been arrived at that the passage of these rays through a gas or vapor deprives it of its insulating properties, during a period extending some time beyond the cessation of the passage of the rays. Moreover, the temporary conductivity or pseudo-conductivity thus set up in a gas may be immediately destroyed, and the insulating properties be restored by the passage of an electric current through the modified gas. Obviously, then, the influence of the rays is opposed by the influence which the current will exert which they permit to flow through the gas, so that at that point at which the opposing influences are equal the maximum possible current through the gas has been attained. Thus this maximum is found to depend, not on the electromotive force causing the current, but on the intensity of the stream of Röntgen rays which passes through the gas and modifies its properties.

In a paper which followed Prof. A. W. Rücker described how Röntgen rays might be used for distinguishing between various qualities of porcelain, those containing phosphatic china being opaque relatively to those porcelains of which this substance is not an ingredient.

Dr. Trouton read a paper on "The Duration of X-Radiation at Each Spark." He found the duration to be sometimes only $\frac{1}{10000}$th of a second, sometimes as long as $\frac{1}{800}$th of a second, and that the duration varied in a very erratic manner. He stated that the duration seemed to depend on the kind of photographic paper used, and on other factors. Prof. J. J. Thomson remarked that radiation so brief showed how inefficient was a spark coil as an instrument for producing it, since the period of the spark was so much longer than the period of the radiation. He himself proposed to use a replenisher and a very high voltage battery for producing the discharge in a focus tube or other Röntgen ray apparatus.

A paper was read by Prof. S. P. Thompson on "The Relation Between Cathode Rays, X-rays, and Becquerel's Rays." Prof. Thompson showed that the shadow of an object within the tube projected by cathode rays on the glass behaved differently from the shadow of that same object projected upon a fluorescent screen outside of and some distance from the glass bulb. When the object was electrified, the cathode shadow on the glass expanded or contracted very markedly, according to the sign of the electrification, whereas no such movement was observable in the shadow on the fluorescent screen, the production of which was due to Röntgen radiation. Prof. Thompson stated that he had observed no image or shadow on the glass at the point where the trajectory of the Röntgen ray shadow passed through the glass.

Prof. Bjerknes attacked the view that the "magnetic spectrum" of the cathode rays, viz., the assortment of the various rays by their deviation in a magnetic field, is a continuous spectrum. He described some recent researches of Prof. Birkeland, of Christiania, which tended to show that this magnetic spectrum is discontinuous, and is broken up into a number of separate lines or patches, after the manner of the luminous spectra of gases. This effect Prof. Bjerknes considered to be inconsistent with the molecular hypothesis of the cathode ray, and he thought it supported the theory of ether waves. Prof. J. J. Thomson elicited the information that the gas in the tube was of a composite nature, and also that no less than 40 distinct lines of cathode rays had been detected at times in the magnetic spectrum.

"Hyper-Phosphorescence," the subject of a paper by Prof. S. P. Thompson, was regarded by Sir George Stokes as tending to support his new theory of non-periodic disturbances. Glow worms, it transpired, exhibit hyper-phosphorescence, and a member of the association who had experimented with the glow of these curious creatures asserted his belief that they "hyper-phosphoresce," even while they do not glow. Prof. Thompson thought that the eye of the glow worm, constructed as it is, independently of refraction, might be a hyper-phosphorescent, or Röntgen ray organ.

LETTERS TO THE EDITOR.

HOW TO PUSH FOR LOCAL LIGHTING BUSINESS.

We beg to call your attention to the inclosed advertisement which is appearing daily in the leading Boston papers. In calling to your attention this advertisement we beg to submit to your consideration the following points:

First—We believe that this is the first time that one of the leading local lighting companies has extensively advertised their current for sale and is a departure from the conservative policy hitherto in vogue with such companies.

Second—It has become a well recognized fact that the Welsbach Gas Burners are more economical for a given illumination than the incandescent lamps, and while the quality of the Welsbach lighting may not be as satisfactory as that of incandescent lighting, the fact that it is a cheaper illuminant results in the use of Welsbach Burners by a good many persons who would otherwise use electricity.

Third—The Welsbach Company have been doing a great deal of advertising and have succeeded in displacing many thousands of incandescents, thus reducing the current output of electric lighting stations throughout the country.

In view of these facts, this move upon the part of the Edison Electric Illuminating Company of Boston, is a direct attack upon the Welsbach interests, and is, therefore, worthy of comment in your paper, for by the general use of Manhattan arc lamps they have found it possible to give their customers a greater and more satisfactory illumination than can be secured by the Welsbach Burners, and at a much smaller cost.

We deem this a matter of sufficient importance to your readers to call your attention to these facts for use as you see fit.

ROBB MACKIE,
Secretary Manhattan Gen'l Cons. Co.

New York City, Oct. 15, 1896.

(The "ad" is an excellent picture of the Manhattan lamp, and calls attention to its local use in a well known hall. Other local companies might well follow suit.—Eds. E. E.)

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

Owing to the inclemency of the weather the meeting of the society announced for last Tuesday was postponed. Due notice will be given of the new date.

PERSONAL.

MR. H. C. ADAMS, JR., having been elected secretary of the Phillips Insulated Wire Conmpany, will hereafter make his headquarters at Pawtucket, R. I., and their New York office, at 39 Cortlandt street, will be closed. Mr. Adams will have charge of the sales department, and will visit the trade as heretofore,

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Central Stations:

CENTRAL STATION ECONOMIES.—By Arthur V. Abbott, C. E., and Franz J. Dommerque, M. E. This article is one of a series and contains a good deal of information, carefully arranged in form of tables. The various headings in one issue are: Fuel Gas. Analysis of Natural Gas, Use, Consumption. Composition of Illuminating Coal Gas; Amount Yielded per ton of Coal; Cost and Relative Cost of Gas and Coal per 1,000 B. T. U. Efficiency of Producers; Composition of Various Producer Gases; Determination of Calorific Value of Gas by Weight, etc. Wood; Average Composition of Wood; Fuel Coefficients for Wood; Composition of Charcoal; Yield of Charcoal, etc.—"Elec. Eng'ing," Oct., 1896.

ELECTRICITY AT COPENHAGEN.—A 200 K. W. Station, run on the three-way plan, two systems at 110 volts for lighting and two for power at 220 volts. Four compound condensing engines, five dynamos, two of four poles furnishing 240 volts and 135 volts at 730 rev. run by one engine and three dynamos of 4 poles each yielding 280 amperes at 490 rev. Two accumulator batteries, consisting of 70 cells each with a capacity of 800 ampere hours. Wiring has a total length of 35 kilometres and consists of underground cables, naked copper wire in tunnels and aerial conductors.—"L'Industrie Electr." and "West. Elec.," Oct. 3, 1896.

SOME CONTINENTAL ELECTRIC LIGHTING STATISTICS.—By F. Ross. Data on the yearly burning times. Several tables in "Elektrotechn. Zeitschrift," Sept. 10, 1896. Abstracted in Lond. "Elec.," Sept. 25, 1896.

ELECTRICAL WORKS "KAISERSLAUTERN."—By Oskar von Miller. Detailed report showing a net profit in one year of over $2,000.—"Die Elektrizität," Sept. 19, 1896.

Electro-Chemistry:

OZONIZED WATER.—According to the Philadelphia "Telegraph" Pepin, of Paris, the well konwn chemist has invented a process of purifying water by electrically introducing ozone, —"Mail and Expr.," Oct. 3, 1896.

IRON SMELTING BY ELECTRICITY.—Dr. G. de Laval and Robsohn, of Stockholm, have obtained from the Swedish Government a concession for the establishment of a company for the smelting of ores in electric furnaces on a large scale.—Lond. "Elec.," Sept. 25, 1896. "Elec. Engr.," Oct. 14, 1896.

APPLIED ELECTRO CHEMISTRY.—By James Swinburne. A Cantor lecture. After some general remarks on the seat of e. m. f. in a cell and on dissociation, author explained for the first time the Ashcroft process for treating the argentiferous sulphide of lead and zinc in the Broken Hill mines.—Lond. "Elec.," Sept. 25, 1896.

Measurements:

RHEOSTENE.—By Dr. J. A. Harker and A. Davidson. A new alloy of iron and nickel, proposed for cheap resistance frames.—Note in Lond. "Elec.," Sept. 25, 1896.

Mechanical:

THE VERTICAL ENGINE FOR STATIONARY PURPOSES.—By Charles H. Manning, U. S. N. Author explains the development of this type of engine and believes in its more general adoption on account of many advantages which are also herein enumerated.—"Cassier's Mag.," Oct., 1896.

BROWN GAS AND GASOLINE ENGINE.—Description of this engine for which the following advantages are claimed: Possibility of changing from gas to gasoline without stopping the engine; avoidance of compression and the making of the electric spark only when needed; possibility of changing speed while engine is in motion and the running of the engine over or under.—"Iron Trade Rev.," Oct. 1, 1896.

AN ELECTRIC DREDGER.—The current for this dredger may be generated on the shore and conveyed to the motor by means of overhead wires or cables. High tension is being used. A 45 H. P. motor is attached to the buckets.—"Scientif. Am. Supplem.," Oct. 3, 1896.

NOTES ON ELECTRIC CRANES.—By E. W. Anderson. Read before the British Assoc. A summary of the relative advantages of the various methods of adapting motors to cranes, and a comparison of electricity with other sources of power, such as hydraulic, steam or rope gear transmission. —Paper in full in Lond. "Elec.," Sept. 25, 1896.

SNAP LIMIT SWITCH OF THE SPRAGUE ELECTRIC ELEVATOR.—An illustration and description of a new automatic snap switch to prevent overwinding.—"Am. Mach.," Oct. 8, 1896.

Mining:

ELECTRIC MINING MACHINERY.—By Irving Hale. Author gives some suggestions as to handling of mining machinery electrically, such as pumps, hoists, drills, etc.—"Elec. Rev.," Oct. 7, 1896.

Roentgen Rays:

THEORIES.—During the discussion on this subject before the British Assoc., the English physicists held that the Röntgen ray is essentially different from the cathode ray, while the German physicists (Lenard and others) believe in the hypothesis of ether waves. Sir Geo. Stokes mentioned that a non-periodic ether disturbance might explain the phenomenon. (The London "Electrician" says that Sir G. Stokes "trotted out this brand new theory"; it is not by any means a new theory, for Dr. M. J. Pupin mentioned this in May last and based it at the time on one of Helmholtz's latest papers. Ed.)—Lond. "Elec.," Sept. 25, 1896, "Elec. Engr.," Oct. 21, 1896.

DURATION OF X-RADIATION AT EACH SPARK.—By Dr. F. T. Trouton. He found the duration sometimes to be only $\frac{1}{10,000}$th of a second sometimes as long as $\frac{1}{250}$th of a second.—Note in Lond. "Elec.," Sept. 25, 1896, "Elec. Engr.," Oct. 21, 1896.

SHORTENING TIME OF EXPOSURE.—Messrs. Eder and Valenta have failed to shorten exposures by using orthochromatic plates, but have shortened it by heating to 50° C. or by a screen of fluoride of calcium, used with a silver bromide and celluloid film.—Note in Lond. "Elec.," Sept. 25, 1895.

SEEING THE RAYS.—G. Brandes found that X-rays could be seen if the crystalline lens were removed from the eye. All the humors of the eye are more or less opaque to them.—From the "Beiblätter," Lond. "Elec.," Sept. 25, 1896.

ON CATHODE RAYS.—By P. Lenard. Read before the Brit. Assoc. An account of his principal experiments in the properties of cathode rays outside the generating tube—Short abstract in Lond. "Elec.," Sept. 25, 1896.

ON THE TRANSPARENCY OF GLASS AND PORCELAIN TO THE ROENTGEN RAYS.—By A. W. Rücker, F. R. S., and W. Watson. Read before the British Assoc. Those kinds containing phosphatic china are relatively opaque to those of which this substance is not an ingredient—Abstract in Lond. "Elec.," Sept. 25, 1896.

Railways:

ELECTRICITY IN CLEANING CITY STREETS.—Description of a self-loading car for removing dirt and refuse from the streets. This car is 50 feet long, 9 feet wide, 12 feet high and is supported on double trucks. It is claimed that all the principal streets of a city may be cleaned between the hours of midnight and 5 a. m. with all the sweepings removed from the city by railway at a cost not exceeding $2 per mile.—"West. Elec.," Oct. 3, 1896.

Storage Batteries:

GERMAN AND FRENCH ACCUMULATORS.—Two new types of accumulators, the W. A. Böse and the "shuttle," are described in "West. Elec.," Oct. 3, 1896.

Telephony, Telegraphy, etc:

AN ELECTRIC TELEGRAPH WITHOUT ANY LINE.—A Danish invention is recorded, the invention of P. Sörensen, principally as follows: An electric battery is placed on the shore. One pole is in contact with the water or moist earth, while the current from the other pole, through a telegraph key and a revolving interrupter, is conducted to a cable, which is laid out to the anchor ground and placed around the latter in a coil with a diameter of 1,000 to 2,000 feet. On board the ship there is a small solenoid to which the telephone is connected.—"Elec. Rev.," Oct. 7, 1896.

ELECTRICAL DISTURBANCES IN SUBMARINE CABLE.—By W. H. Preece, F. R. S. Paper read before the British Assoc. Section A. Author explained some peculiar forms of disturbance on new cables.—Lond. "Elec.," Sept. 25, 1896, "Elec. Engr.," Oct. 14, 1896.

Power Transmission:

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.—By Louis Duncan, Ph. D. Paper read before the Amer. Inst. of Elec. Eng's., Sept. 23, 1896. Speaker reviewed the principal methods of transmission and distribution now in vogue. Although stating no new features of any sort, the paper forms an excellent résumé of the position which electrical transmission and distribution now occupies.—"Elec. Rev.," Oct. 7, 1896, "Elec. Engr.," Oct. 7, et seq.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

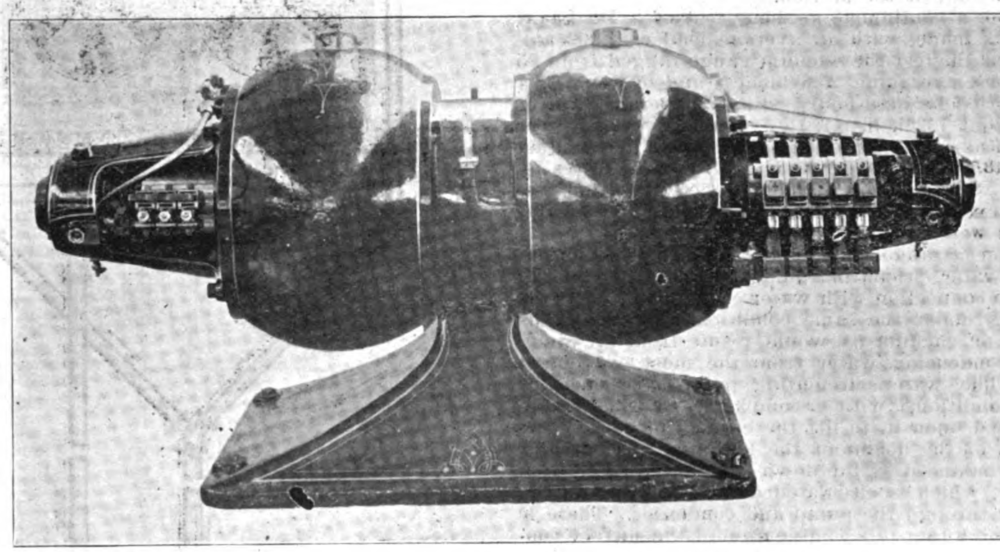
SHULTZ BELTING CO.

President J. A. J. Shultz, of the Shultz Belting Co., of St. Louis, writes us that one of the latest of the large trolley plants belted up by them was that of the Missouri Electric Railway Co., of Webb City, Mo. It took several twenty-eight-inch belts. Mr. Shultz expects a brisk revival in business later on, and, knowing the electrical field intimately, stands well to secure his share.

THE BOOSTERS IN THE CONGRESSIONAL LIBRARY WASHINGTON.

IN our last issue we printed an illustrated description of the electric lighting plant in the new Congressional Library at Washington. One of the features of this plant is a series of five boosters, which were made necessary by the great length of the feeders, some of which are 600 feet long.

These boosters, one of which is illustrated in the accompanying engraving, were built by the Northern Electrical Manufacturing Co., of Madison, Wis., and their object is to keep the potential constant at the centers of distribution. Each booster consists of a motor dynamo combination on one shaft, the motor being run direct off the bus bars and the dynamo being in series with the feeders. This latter arrangement, adopted by Dr. Cary T. Hutchinson, consulting electrical engineer for the government, is a departure from the usual practice of connecting the booster to the bus bars, and presents the advantage of effecting the necessary change in condition gradually, thus preventing flickering in the lamps. These boosters raise the potential from 6 to 12 volts at the feeder ends, depending upon the current load.



NORTHERN BOOSTER IN NEW CONGRESSIONAL LIBRARY, WASHINGTON.

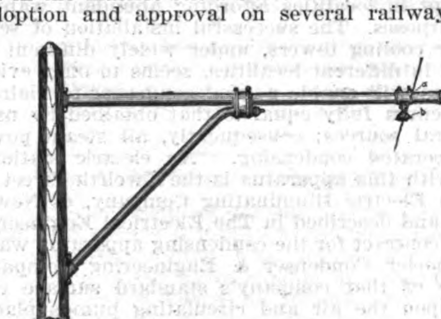
THE EXCELSIOR RAILWAY BRACKET.

The Excelsior Railway Bracket has been placed on the market by the John Simmons Company, No. 110 Centre street, New York, with a view to supplying a bracket as simple and durable as possible. To this end bolts have been discarded, because vibration loosens the nuts and eventually the bolt itself; cast iron has ever been condemned, as it will crack in severe weather; screwed angle joints were replaced with an elastic band, because of the saving of labor, assembling and erecting.

The "Excelsior" bracket is fitted throughout with malleable iron fittings. The joint of the curved brace and the arm consists of a sleeve around both pipes, which are about 1¼ inch apart. Between the pipes are two filling pieces ⅜ inch thick, closing the open space between pipes, and made into one casting by a longitudinal rib. When the set-screws bear upon the arm, the whole joint becomes rigid, but still remains so elastic that the screws are not affected by vibration.

There has, however, another important advantage been kept in view. Loosening screws and withdrawing the filling piece, enables one to bring the curve of the brace clear through the sleeve without removing either flange or acorn. Thus, by bringing brace and arm into parallel position the bulk of the bracket is reduced to a minimum of space for shipping and carting. The flexibility of this bracket is as obvious as its strength and lightness.

Though in the market but a short time, the "Excelsior" has found adoption and approval on several railways of recent construction. Sizes and lengths are variable, and all requirements can be met, no matter what they be. The manufacturers of this bracket also carry steam and electrical engineering supplies, iron pipe, standard and extra heavy fittings and valves, and have the facilities of the largest pipe-cutting establishment in New York.



THE EXCELSIOR RAILWAY BRACKET.

ZIEGLER ELECTRIC CO.

A handsome and important catalogue has been issued by the Ziegler Electric Company of Boston, which, from dealing chiefly in school and educational apparatus, has grown into one of the leading makers and dealers in supplies and instruments and is now one of the powers in the land. The present book of 200 large pages, carefully illustrated, deals specifically with their electrical trade, and embraces measuring and testing instruments, bells, batteries, lamps, generators, motors, shades, resistances, telegraph appliances, switches, wire, etc. Sizes, number and prices are given in detail. Another catalogue issued by the house from their headquarters, at 141 Franklin street, Boston, is devoted exclusively to physical, chemical and scientific apparatus and material.

CONSOLIDATED INSULATED TUBE CO.

The Consolidated Insulated Tube Company, John Hancock Building, Boston, inform us that they have purchased all the rights, title and interest, together with machinery and patents of the Builders' Insulating Tube Company, of Lynn, Mass., and the Kinney Electric Conduit Company, of Boston, and that they will manufacture a full line of plain and armored tubing for interior and underground wiring. They will endeavor to make the best goods and to effect prompt shipments.

MR. JOHN F. OUTWATER, representative of Hugo Reisinger, New York, was in Chicago on a business trip last week.

THE BARNARD WATER COOLING TOWER FOR ELECTRICAL STATIONS.

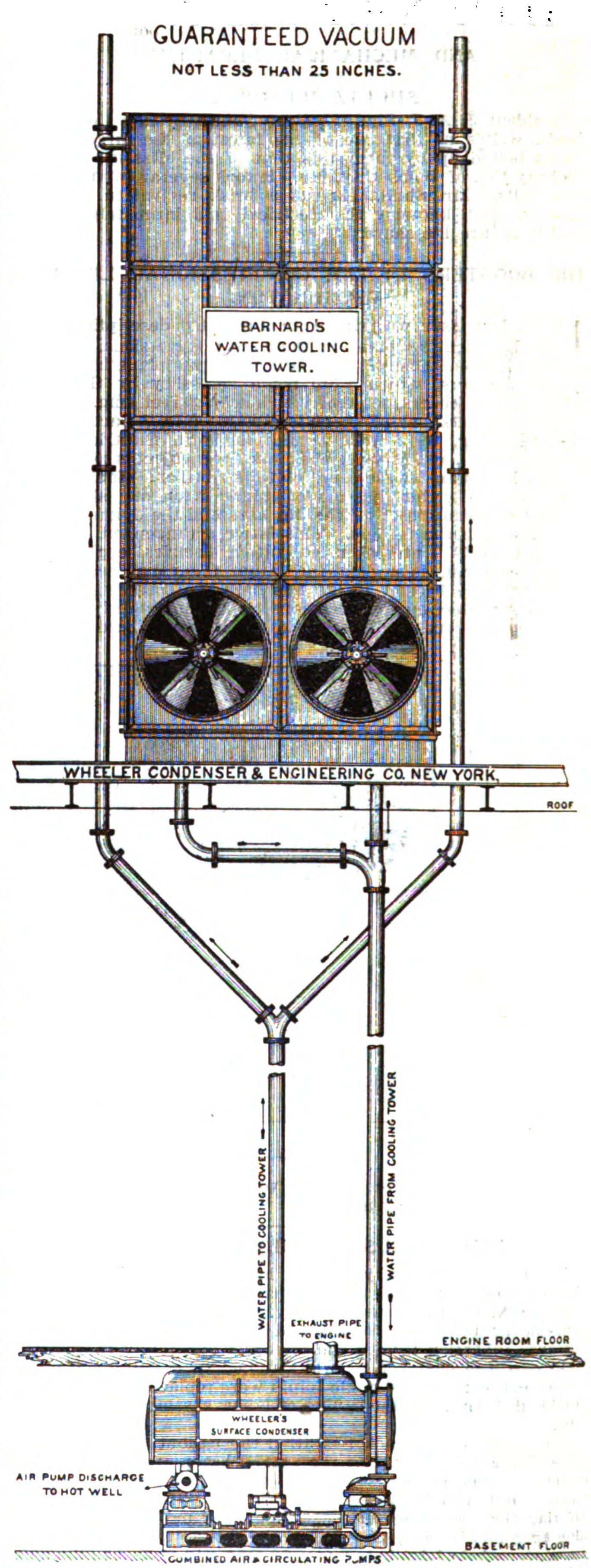
THE use of multiple cylinder condensing engines, requiring from 1¼ to 2 pounds of coal per indicated horse-power per hour, according to size, has, until recently, been prohibitory, except in localities affording abundant water for condensing purposes. The successful installation of several Barnard water cooling towers, under widely different conditions of use and in different localities, seems to offer evidence that these towers will enable a good condenser to maintain a degree of vacuum fully equal to that obtained by using water from natural sources; consequently, all steam power plants may be operated condensing. An electric station recently equipped with this apparatus is the Twelfth Street station of the Edison Electric Illuminating Company, of New York, as illustrated and described in The Electrical Engineer of Jan. 8, 1896. The contract for the condensing apparatus was awarded to the Wheeler Condenser & Engineering Company. It included one of that company's standard surface condensers, mounted upon the air and circulating pumps placed in the basement, and a Barnard water cooling tower located on the roof, which is some 70 feet above the condenser. The up discharge pipe from the top of the condenser conveys the hot water to the top of the tower, and the pipe from the bottom of the tower conducts the cooled water down to and through the circulating pump and condenser to the up pipe. This water is kept in continuous circulation through the channels above described, and, sufficiently cooled in its transit through the tower to enable the condenser to maintain 25 inches vacuum, or better.

The apparatus works smoothly and quietly. To see it in operation and the work it accomplishes, one would be more inclined to believe the injection water came from a river 10 feet below the condenser, rather than from a small tank 70 feet above, and on the roof of the station.

On April 2, 1896, a continuous six-hour test of a De Laval steam turbine was made, with an average load of 1,402 amperes. Throughout the test the vacuum gauge ranged from 25 inches to 26 inches, averaging 25.6 inches; and on Sept. 2 a full load was carried for five hours, with an average load of 3,628 amperes (about 732 i. h. p.); the vacuum averaged over 25 inches. It will also be of interest to state that the exhaust steam averaged 13,535 pounds per hour, and that the losses by evaporation, etc., were only 3 per cent. of the circulating water, and did not exceed 80 per cent. of the boiler feed-water when the engines were working condensing.

The combination arrangement of the Wheeler condenser, with its air and water circulating pumps, is particularly well adapted for use in connection with water cooling towers, as the air pump operates under the same conditions and maintains the same degree of vacuum as would result from an abundant supply of condensing water from the most convenient natural source. The water circulating pump also operates under ordinary conditions, with a comparatively small additional duty imposed upon it, to lift the circulating water possibly 25 per cent. of the height of the building. The greater part of the lift is balanced by the down column of water from the cooling tower, which is circulated down one pipe and up the other, passing through the pump and condenser. There is not a building so high that this combination of the surface condenser in the basement, and the cooling tower on the roof, is not usable, as the apparatus is wholly independent of distance, either horizontally or vertically. Roof structures are largely a necessary in cities, but where ground room is available, the cooling tower may be situated at any convenient point.

The Barnard cooling towers are continuously efficient, as they are subjected to no wear or oxidation, the superficial surfaces being steel wire cloth (galvanized after weaving), made in mats and suspended in a vertical position, properly placed. The hot water from the condenser is evenly subdivided and distributed over the upper edges of the mats, uniformly flowing over and through them, compelling every square foot of the mats to do a proportionate amount of work. The space occupied by the tower is small, and the power required to operate is estimated at from 2 per cent. to possibly 5 per cent. of the main engines, according to conditions.



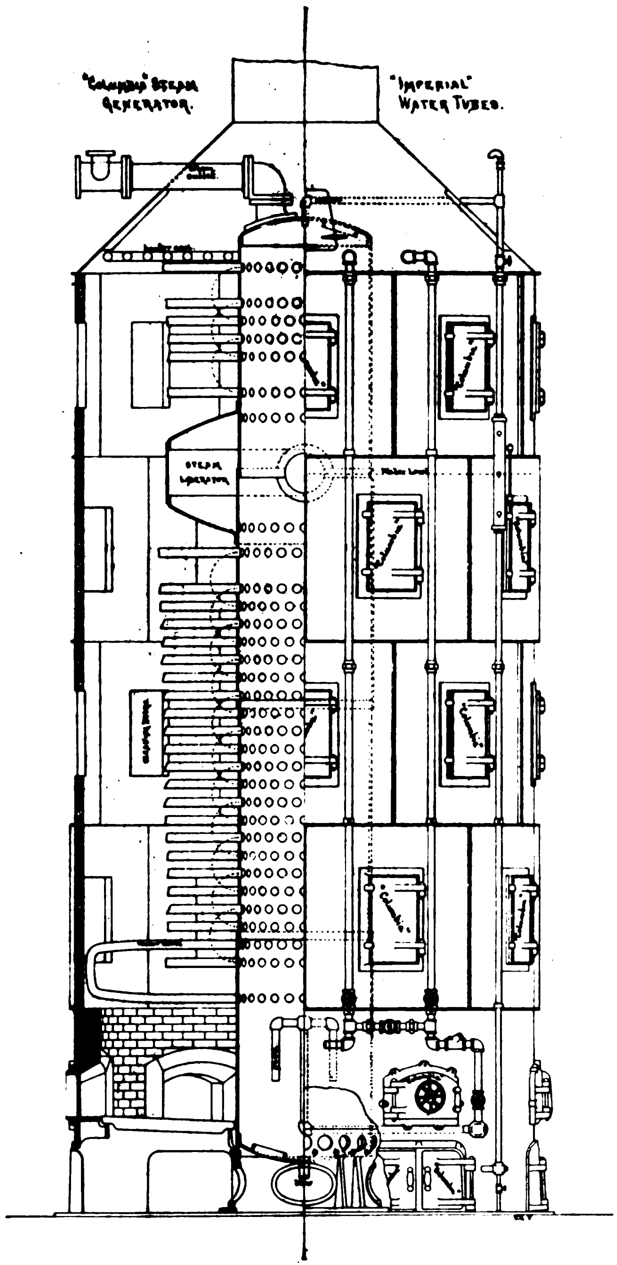
COMBINED BARNARD WATER COOLING TOWER AND WHEELER CONDENSER.

MR. JOHN LYNCH, formerly State Agent for the Universal Electric Company, Cleveland, O., has recently received a similar appointment to represent J. C. Wormley & Co., of the Marquette Building, Chicago, in the State of Minnesota, with headquarters at 124 Davidson Block, St. Paul.

THE PURITAN ELECTRIC COMPANY has been formed in New York City to make apparatus for furnishing and using electric power. The directors are J. R. Burnet, F. P. Delafield, B. A. Gould, Jr., Carl Schurz and Cortland Betts. The capital stock is $100,000.

THE COLUMBIA STEAM BOILER.

SINCE the early days of heat tube steam boiler practice every conceivable effort has been made to so construct them that an assured circulation, economy of space, efficiency of heating surface and cheapness of construction and repairs



THE COLUMBIA STEAM BOILER.

shall be provided for. Especially is it desirable in this class of boiler that it can be cleaned.

All these desiderata have, it is claimed, been combined in the Columbia boiler, built by the Columbian Steam Boiler Works, of North Eighth street and Driggs avenue, Brooklyn, N. Y., and illustrated in the accompanying engraving. As seen, it is composed of a central vertical shell surrounded by layers of U-shaped tubes. At the water line level is placed an enlarged chamber to provide for a steady water level and a ready liberating surface. It has an outer casing to form firebox and combustion chamber and to compactly inclose the boiler and tubes, as well as the furnace at the bottom.

In the construction of the Columbia boiler, none of the parts are bolted together, no packed joints, no diaphragm plates and no forced circulation are employed. This flexible construction, therefore, allows full play to the various parts and provides against all unequal expansion. There is ample steam and water space and the water surface is far enough from the steam exit to insure against any picking up of the water of the steam after the water spout method. The large water surface avoids rapid fluctuations in water level and provides at the same time for the ready release of the steam generated.

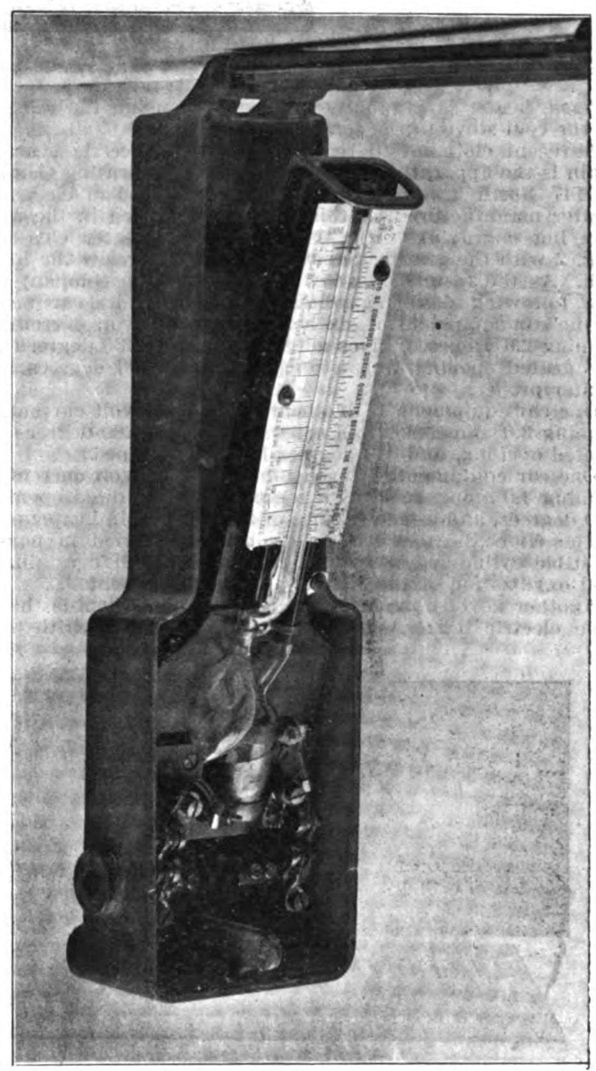
To assure cleanliness in the tubes and ready means for examination, they are shaped to large radius curves, with a quick rise to assist the circulation, and every possible provision is made to keep a supply of water within the tube portions most exposed to heat. Cleansing apparatus can be readily inserted and the boiler thus kept constantly at its maximum efficiency.

The question of safety has also been given every consideration, every part subjected to pressure or other stress being carefully proportioned to meet it.

The company will also shortly bring out a straight tube boiler.

THE WRIGHT DEMAND METER.

How to charge customers for current, and be just to all, and at the same time realize a profit on the investment, has always been a vexed question with station managers. The giving of discounts according to amount and character of the current consumed partly solves the difficulty, but only partly, since it leaves the station manager always in the dark as to the actual nature of the customer's consumption, especially



THE WRIGHT DEMAND METER.

as to the maximum current which he draws, and for which provision has got to be made at the station. The Wright Maximum Demand Meter has been designed to meet this difficulty, and its use abroad has been followed by the most gratifying results. Mr. R. S. Hale, of 31 Milk street, Boston, Mass., has acquired the American rights for this meter, and his article, appearing elsewhere in this issue, gives a good idea of its great usefulness. Mr. Hale will be glad to give any additional information regarding it.

The apparatus is extremely simple and is described in detail in the article by Mr. Hale, referred to above. The accompanying engraving shows the meter with the cover open and the scale swung forward and upward. As the entire apparatus

contains no moving parts, except the liquid in the tube, which is hermetically sealed, it is impossible for it to get out of order. Mr. Hale has already received trial orders from the Edison stations in New York, Boston, Chicago and elsewhere.

THE GLOBE ELECTRIC HEATERS.

With the approach of winter, electric railway companies are looking about for means to heat their cars properly. The most convenient method, of course, is the electric, and hence the electric heater is gradually but surely causing the relegating of the coal stove to the scrap heap.

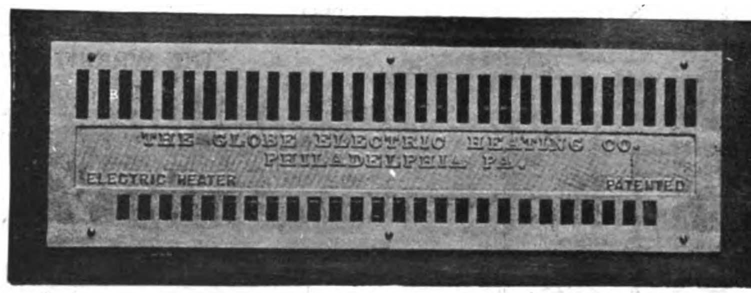


FIG. 1.—GLOBE ELECTRIC CAR HEATER.

A recent claimant to recognition in the electric heater domain is the apparatus of the Globe Electric Heating Company, of 147 North Twelfth street, Philadelphia. The electric car heater manufactured by this firm is illustrated in the accompanying engravings, Fig. 1 showing the heater closed and Fig. 2 with the grating removed, exposing to view the heating coil. As the results of a six months' test the company gives the following data regarding the work of its car heaters:

One car equipment of six heaters on a 500-volt current, consuming 2.6 amperes, gives a temperature of 180 degrees F. at the grated opening, and a temperature of 300 degrees in the heater proper.

One car equipment of five heaters on a 500-volt current, consuming 3.0 amperes, gives a temperature of 200 degrees F. at grated opening, and 340 degrees in heater proper.

One car equipment of ten heaters on a 500-volt current, consuming 4.0 amperes, gives a temperature at grated opening of 160 degrees, and a temperature of 290 degrees in heater proper.

The Globe heaters have their coils embedded in non-combustible cylinders, in such a manner that all crystallization and oxydization of the wire of the coil is prevented.

Another novelty manufactured by the same firm is the portable electric heater, illustrated in Fig. 3. This little heater contains six heating coils similar to that shown at A. They are screwed into place by means of an ordinary lamp socket. They can thus be removed and renewed like an ordinary incandescent lamp.

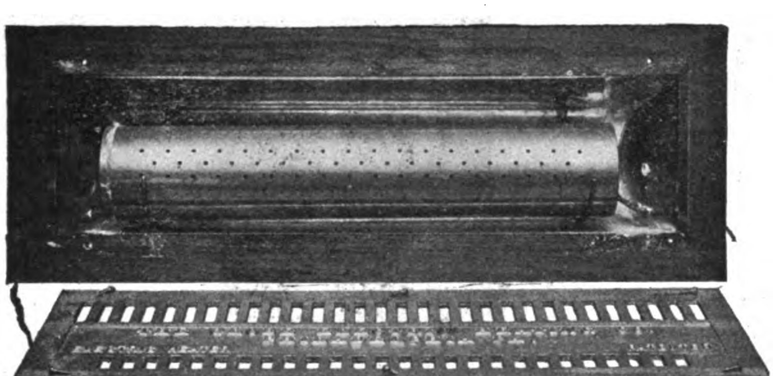


FIG. 2.—GLOBE ELECTRIC CAR HEATER.

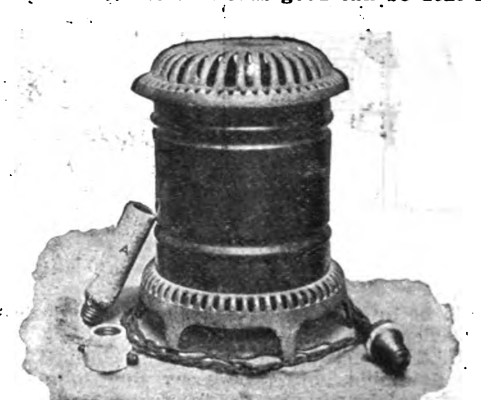


FIG. 3. GLOBE PORTABLE ELECTRIC HEATER.

This portable heater consumes 3.5 amperes at 110 volts, the temperature of the coils being 680 degrees F. The little heater is specially adapted for office use, heating of bathrooms, etc.

R. D. NUTTALL COMPANY have removed their Boston office from 180 Summer street to 31 State street. Mr. Chas. N. Wood, who has had charge of their New England business in electrical and railway supplies, will continue in charge at the new location, where they will be glad to receive inquiries and fill orders promptly.

WOOD PRESERVATION FOR ELECTRIC RAILWAYS.

A large portion of the construction of electric street railways consists in the pole line and in the track, which again depends largely on the quality and durability of its wooden sleepers and stringers. If the poles and sleepers can be preserved, the physical condition and the value of the property is to that degree enhanced. The subject is one that has long received the careful and serious attention of electric railway and electric lighting men, and a good means of preservation is universally recognized as a desideratum of the first importance. The thought of the American Street Railway Association has already been engaged with the matter, and the present is a fitting time to point again to the good results accomplished with Carbolineum Avenarius, sold by the Carbolineum Wood-Preserving Company, of which Mr. C. S. McKinney is manager, the New York office being at 21 Cliff street. The users of this material are legion, and among the best pleased are those in the electrical field, as the following little list will serve to exemplify: Western Union Telegraph Co., Southern Bell Telephone and Telegraph Co., American Bell Telephone Co., Ohio Valley Telephone Co., The Mason Telephone Co, Southwestern Telegraph-Telephone Co., Titusville (Fla.) Electric Light Co., Sumter (S. C.) Electric Light Co., Edison Electric Illuminating Co., N. O. La.; Consumers' Electric Light and St. R. R. Co., Tampa; Austin Rapid Transit Co., Austin Water, Light and Power Co., Memphis Light and Power Co., Laredo Electric and Railroad Co., Erie Telegraph and Telephone Co.

It is obvious that when the ties are well preserved, under such high grade asphalt and paving as many roads and cities now lay, the necessity of spoiling such pavement by ripping it up is reduced to a minimum. A great many testimonials could be cited in favor of this preservative, but the company will be glad to send data of all kinds upon application. It is surprising to note how much miscellaneous good can be done by the general use of the specific, so long as the genuine article is used, a point upon which the New York Central Railroad lays particular stress in its engineer's instructions to all its contractors and inspectors.

A FEW POINTERS ON SPECIALTIES.

The John Wennstrom Company, of Forty-first street, Brooklyn, report a good inquiry for their jewels for all classes of recording instruments, which they are now furnishing in large quantities to the makers of such electrical apparatus. They also supply rubies for phonographs, and, in fact, the jewel work in all apparatus of such character. They make also fine tools in these lines and furnish dies and drawplates, their

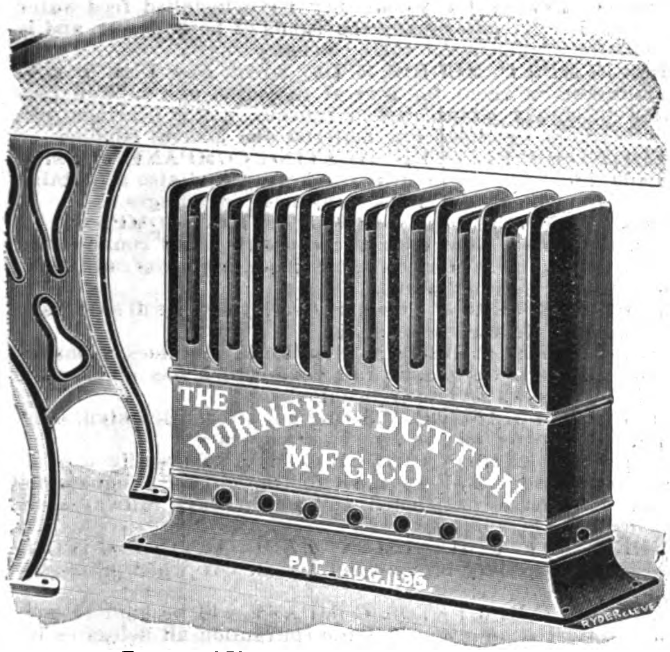
sapphire dies for filament drawing being well known. They will be glad to receive and respond to inquiries on all such matters.

In a kindred line is the work of Mr. D. S. Plumb, 24 Boudinot street, Newark, a large manufacturer of special clockwork for recording apparatus of all kinds, and of counters for gas, electric and water meters. Mr. Plumb supplies not only a large amount of the material thus used in the electrical trade but that used in the steam line, for recording gauges and other fine apparatus. He makes also special tools, and will be glad to furnish estimates on work from samples, or models and drawings. Concerns introducing new appliances of a delicate mechanism will do well to communicate with him.

THE DORNER & DUTTON ELECTRIC CAR HEATERS.

THE accompanying illustration represents one of the new types of heater now being introduced by the Dorner & Dutton Manufacturing Company, of Cleveland, O., and is worthy of special mention as it embodies a new principle in electric heater construction, doing away entirely with the use of wire. Each heater contains 12 feet of 1½ inch porcelain tubing, filled with carbon compound, which cannot be burned out. Four amperes passing through this compound will keep the outside of this tubing at a temperature of 310 degrees. This tubing is encased in neat open work frames, which allows a free circulation of air, thus insuring free radiation of heat.

The heat passing out through the openings of the frames does not heat the frames sufficiently to burn any kind of



DORNER & DUTTON ELECTRIC CAR HEATER.

cloth; hence, the frames can be put outside of seats without any danger of burning clothing, and thus getting greater benefit from the heaters than when put under the seats. The tubes having a much greater surface exposed than wire, give off a greater heat than wires, and cannot burn or rust out.

A set of these heaters consists of four heaters wired two in series, which are equal to 48 feet of 1½ inch steam pipe, except that the tubes of these heaters will, with four amperes on a 500 volt circuit, be 90 degrees hotter than the steam pipe will be with steam at 85 pounds pressure.

The company furnish two switches, so that only one-half, or two amperes of current may be used when that is sufficient.

The company manufacture two styles of heaters for street car service. That shown in the accompanying engraving, intended for cross-seats, is compact and can be placed in any convenient position and fastened to the floor. Another style for side seats, can be fastened to the sides or risers of seats and does not deface the finish of the car.

The heaters are waterproof, very simple in construction, thoroughly insulated and require no repairs. These heaters are also adapted for buildings, house or office use.

THE CENTRAL ELECTRIC COMPANY think that there is a decided improvement in feeling among the trade. Buying is freer and the general indication such as to warrant hopes for a reasonably good fall trade.

GALE'S COMMUTATOR COMPOUND.

K. McLennan & Co., of Chicago, sole manufacturers of the celebrated Gale's Commutator Compound, report their sales during the past year more than double that of any previous year. The satisfaction which the compound has given generally has exceeded their most sanguine expectations, and they are in receipt of enough testimonials unsolicited "to fill a volume." In response to numerous requests from their customers, the Fort Wayne Electric Corporation recently made a careful and exhaustive test, and the result, as expressed by them, is as follows: "The application of Gale's Commutator Compound was attended with very satisfactory results. A slight sparking occurs at the moment of applying the compound. This, however, disappears instantly, and the commutator assumes a hard gloss. We recommend it to those having trouble with sparking, cutting of commutators, etc." The test was made under the personal supervision of Mr. Barnes. Mr. M. J. Isaacs, of K. McLennan & Co., states that this is but one of hundreds of similar tests, and with similar resu'ts. He will be at the convention with sufficient samples, so that every delegate may make a test and convince himself of the merits of the compound. In the mean time samples may be had on application to their office, Marquette Building, Chicago.

TELEPHONE MANUFACTURE IN ST. LOUIS.

Among the hustling, enterprising different manufacturing companies of the city of St. Louis may be mentioned the Missouri Telephone Manufacturing Company, located at Nos. 917 and 919 Market street, in close proximity to the Auditorium, where the display of the electrical apparatus was made during the convention. They manufacture everything in telephones and switchboards. The latest acquisition to their line of telephones is an instrument designed for street railway work, the operation of which is as follows: A telephone is carried upon each street car. In case of accident or at any time should a conductor des're to communicate with headquarters, or any of the central offices he takes his telephone to the nearest pole and hangs it on the wires. This puts him in circuit. He proceeds to ring up the office, and after communicating lifts his telephone off the hook and takes it with him back to his car. By the aid of this instrument each car upon the road may at any and all times, within a few seconds, communicate to headquarters—a very valuable feature. They are placing a very low quotation upon this instrument, desiring to introduce them, believing that a large sale will more than pay for the trouble and pains expended in producing an instrument of this character. The entire instrument is no larger than an ordinary magneto bell. They will be pleased to show this instrument to the street railway men who visit St. Louis. They will also have samples of the same on display at the exposition and at their own display at the St. Louis annual exposition. All street railway men should call upon this company while visiting St. Louis, and they will be repaid by being presented with a very elegant calendar, beautifully got up, something entirely new, to hang upon their walls in their offices at home, which will help them to remember their visit to St. Lou's.

GOUBERT FEED WATER HEATERS IN STREET RAILWAY PLANTS.

The Goubert Manufacturing Company has enjoyed remarkable success in the introduction of its feed-water heater and its Stratton steam separator into electric railway plants. The capacity in some of the installations is enormous, showing that intelligence has governed in the selection of apparatus and in the plans to obtain high station economy. We give below a list of some of the roads now using Goubert heaters: St. Louis & Suburban Street R. R. Co, St. Louis, Mo., 2,400 h. p.; Metropolitan Street Railway Co., New York City, 10,800 h. p.; Third Avenue Cable Railway, New York City, 6,000 h. p.; Atlantic Avenue R. R. Co., Brooklyn, N. Y., 5,000 h. p.; Nassau Electric R. R. Co., 2,000 h. p.; Syracuse Street Railway Co., Syracuse, N. Y., 1,600 h. p.; Buffalo Railway Co., Buffalo, N. Y., 4,000 h. p.; Staten Island Electric R. R. Co., Staten Island, N. Y., 2,700 h. p.; West Side Street Railway Co., Elmira, N. Y., 400 h. p.; Newburgh Electric Railway, Newburgh, N. Y., 500 h. p.; Bergen County Traction Co., Fort Lee, N. J., 700 h. p.; Consolidated Traction Co., Jersey City, N. J., 1,500 h. p.; New Jersey Electric Railway Co., Secaucus, N. J., 1,000 h. p.; Fairhaven & Westville Electric Railway, New Haven, Conn., 1,220 h. p.; Waterbury Electric Railway, Waterbury, Conn., 1,500 h. p.; Metropolitan Railroad Co., Washington, D. C., 2,500 h. p.; Brooklyn Street Railway Co., Cleveland, O., 1,600 h. p.; Philade'phia Traction Co., Philadelphia, Pa., 12,000 h. p.; Electric Traction Co., Philadelphia, Pa., 1,200 h. p.; Portland Railroad Co., Portland, Me., 1,840 h. p.; Worcester Electric Railway, Worcester, Mass., 500 h. p.; Telegraph Avenue Electric R. R., Oakland, Cal., 390 h. p.; Halifax Electric Tramway

Co., Halifax, N. S., 1,200 h. p.; Montreal Street Railway Co., Montreal, P. Q., 2,000 h. p.

PHŒNIX CARBON BRUSHES.

The fact that the Phoenix Carbon Manufacturing Company, of St. Louis, has facilities for making 5,000 carbon brushes daily gives an idea of the extent to which the use of such brushes has become universal. In fact, no small part of the success of the trolley car is due to the introduction of the carbon brush and to the improvement of that article. The Phœnix Carbon Company was formed under the laws of the State of Missouri, and has a paid up capital of $160,000. It manufactures everything—electric light carbons, battery and telephone carbons, and all sorts of carbon specialties, such as brushes of all kinds and sizes.

Col. S. G. Booker, the superintendent, has been in the carbon business from the start, and has made it a special study in all of its details, being well known in the art and trade.

STEAM ENGINE GAUGES AND INDICATORS.

A visit to Schaeffer & Budenberg's busy factory, in Brooklyn, shows at once that despite the average dullness, the demand for their product and the quantity of their output have not declined. Quality is a great factor when it comes to holding trade, and this is a fact plainly visible in the reputation built up by this concern. Their gauges for all purposes are acknowledged to be the standard of the world. We understand they have sold upwards of 2,000,000, and the striking assertion is even made that they are at present turning out more than half of the whole product of all the manufacturers in Europe and America combined. Their tachometers, portable and stationary, used for the purpose of indicating the speed of dynamos and high-speed engines, are meeting with a brisk demand in the electrical trade. The Metropolitan and Columbia pressure gauges are of their make, and used everywhere for indicating steam, air, water, gas, ammonia and hydraulic pressures. Looking through their interesting and instructive catalogues one finds enumerated also such specialties as Thompson's steam engine indicator, Prof. R. C. Carpenter's throttling steam separating and coal calorimeters; test pumps, Acme steam traps, engine registers, dynamometers, injectors, test pumps for boilers and pipes, engine and boiler appliances in general. The large catalogue is divided into several sections, Part IV., for example, being devoted to steam engine indicators and Part I. to steam gauges. Any and all of their catalogues will be sent to any address on application by our readers. The general offices and works of Schaeffer & Budenberg are in Brooklyn; the New York salesrooms are at 66 John street, and the Chicago quarters at 22 West Lake street.

PLEASE PUSH IN THE CARS—DON'T SHOVE.

Every one who rides in a positively modern, up-to-date trolley car, cannot fail to be impressed with the number of improvements it embodies. Not the least of these, so far as the comfort of the passenger and convenience of the conductor is concerned, is the push button, handily placed at the back of each passenger, so that the signal to stop can be given to the conductor, without rushing, crowding or anxiety, under any circumstances. Huebel & Manger, of Brooklyn, N. Y., have furnished a great many of these car pushes during the past two years, for cars all over the continent. They are a great feature in the smooth operation of a trolley road.

EDISON-BROWN PLASTIC RAIL BONDS.

There is no detail of electric railway track construction of greater importance than the joint between the rails. This applies to the mechanical as well as to the electrical element, for the latter may cause not only a constant loss of power, but if defective may deflect the current into neighboring pipes and conduits, with results that are only too well known.

To what extremely low resistance such joints can be brought is shown in a table of tests of the Edison-Brown plastic rail bond just issued by Mr. Harold P. Brown, of 68 Broad street, New York, and printed in our advertising pages this week. These tests which were made with Weston instruments, show that the various types of plastic bonds with a current of 1,500 amperes passing through the joint cause a drop in potential varying 0.9 to .0064 volt, depending upon the weight of rail and type of bond employed. The best record was made with a joint consisting of a V-shaped slot cut in the web of the rail at the joint, with a steel cup holding the plastic alloy. With 100 amperes passing through the joint the drop was only .0004 volt, while with 1,500 amperes, as stated above, the drop was .0064, with the joint cold at the end of ten minutes. This is a remarkable showing and will not fail to impress itself on those directly interested.

ADVERTISERS' HINTS.

Department News Items will be found in advertising pages.

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POWER TRANSMISSION.

TRANSMISSION OF NIAGARA POWER TO BUFFALO.

BY ORRIN E. DUNLAP.

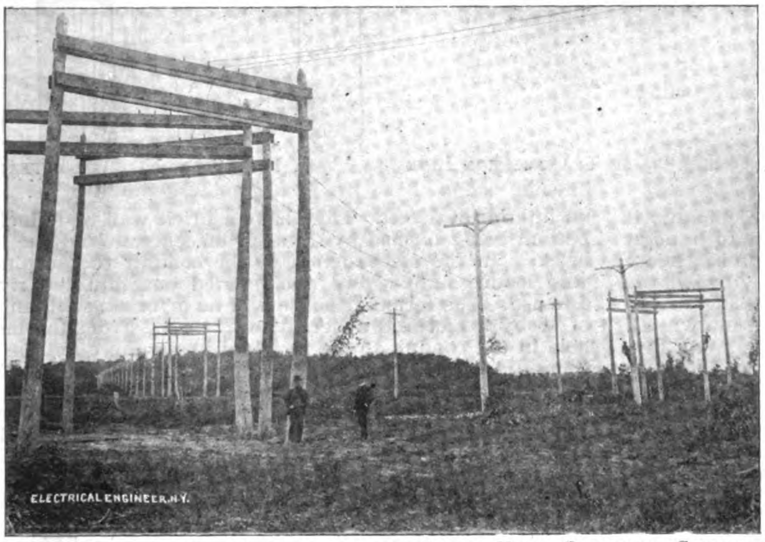
THE progress that has been made in the construction of the Niagara-Buffalo power transmission line is such that it cannot fail to be satisfying to even such an anxious people as the residents of Buffalo. The contract for the work is held by the White-Crosby Company, who have as their superintendent Mr. John A. Wilson, with his office in North Tonawanda. Under the efficient supervision of Mr. Wilson, the transmission line has been built with truly wonderful rapidity, and to-day it stands as another connecting link between the Queen City of the Lakes, Buffalo, and the Power City of the World, Niagara Falls.

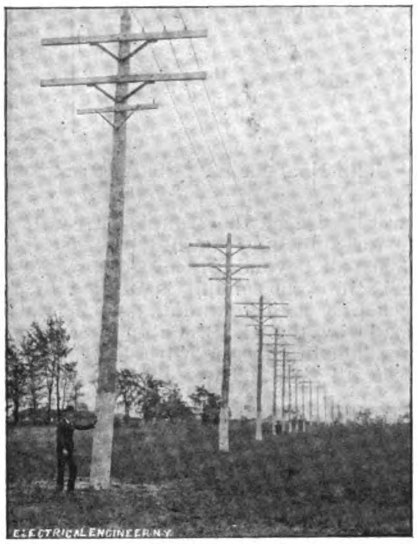
For nearly twenty-six miles this link of copper stretches in its brightness through city and village and across country, and as there are three conductors, or one three-phase system, the total length is nearly seventy-eight miles.

Starting from the transformer building on the east side of the Niagara Falls Power Company's central power station, the transmission line extends along the northerly side of Adams avenue on the power company's property to a point one and one-half miles east of Sugar street, where it leaves Adams avenue, and runs along the west side of and adjacent to the right of way of the Niagara Junction Railway. It then runs to a point about 500 feet north of the Mile Line road, where it turns at right angles and runs nearly due east through the power company's land and through private property to a point about one mile north of La Salle. From this point it runs along adjacent to the old mile line survey all the way to Tonawanda Creek, following, in general, the old line established as far back as 1798 and re-established for this purpose by surveys, old maps, notes and persons and by a new map filed in the county clerk's office in Lockport.

The line crosses the Tonawanda Creek at or near Division street, in the village of North Tonawanda, and then passes in a southerly direction across the right of way of the proposed Buffalo, Thousand Islands & Portland Railroad to Ellicott Creek, which it crosses, and continues in a southerly direction over private property to the south line of the village of Tonawanda. It follows this boundary line in a westerly direction for about a mile and a quarter, then crosses private property in a northwesterly direction to the east bank of the Erie Canal, which it strikes near the foot of Hinds street, in the village of Tonawanda, and for the remaining distance to Buffalo it extends along State property, the canal bank, on the east or heel path side. The pole line ends about 300 feet north of Brace street, in the city of Buffalo, at which point the conduit work commences, and for the last 4,200 feet the cables will be laid underground.

Throughout its length the transmission line runs for nearly eighteen miles through private property, a right of way 30 feet wide having been purchased by the Niagara Falls Power Company. Two and one-half or three miles of the line is built within the limits of the city of Buffalo, and about five miles of it along the bank of the Erie Canal, the right of way for which was obtained through the franchise granted by the State to the Cataract General Electric Company, this being the first construction going to show how widely beneficial the granting of this franchise is likely to be, not alone to the canal, should electricity be adopted as the motive power thereon, but to many villages and cities throughout the State. In its route the transmission line passes through the City of Niagara Falls, the town of Niagara, the town of Wheatfield, the village of North Tonawanda, the village of Tonawanda, and also through a small portion of the city of Buffalo. These places are located in Niagara and Erie counties, which naturally will receive the greatest benefit from the Niagara power development and transmission.





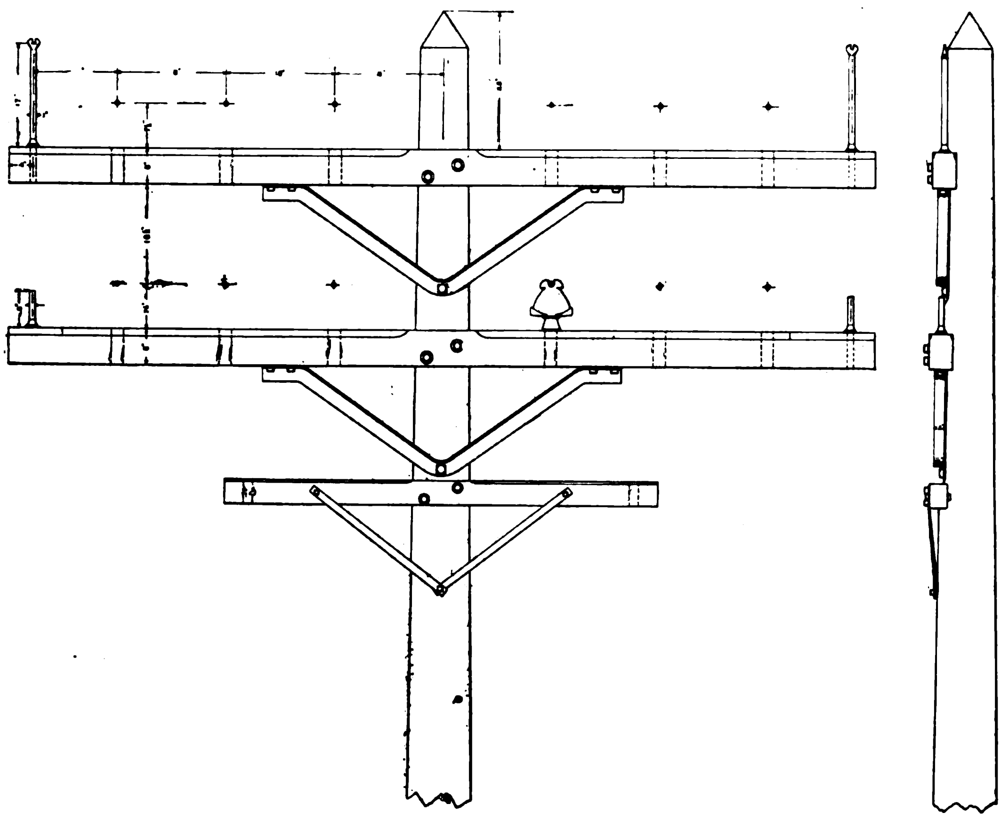
THE NIAGARA-BUFFALO POWER TRANSMISSION LINE.—VIEW SHOWING CONSTRUCTION AT POINTS OF TRANSPOSITION, CURVES, AND STRAIGHT RUN.

The construction of this transmission line has been a task of no small magnitude. Work was commenced on August 14, and nearly 200 men put to setting poles. In all, there were six gangs at work on the pole erection, two of which worked from the Falls toward Tonawanda, two from Tonawanda toward the Falls and two from Tonawanda toward Buffalo. In length the poles vary from 35 to 65 feet. They are of white cedar, shaved, and have all been placed in position. In order to facilitate the work, the poles were shipped to North Tonawanda, La Salle and Niagara Falls, and when the construction was along the canal a boat was used, the White-Crosby Company having a steam tug and a naphtha launch on the work to transport men to and from the scene of their labors. These

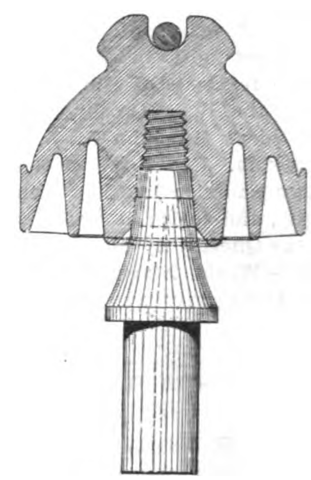
boats were kept at Tonawanda, the canal being used in the run toward Buffalo and the river for trips down stream.

One of the illustrations accompanying this article portrays the manner in which the conduit was constructed along the bank of the Erie Canal in Buffalo. Starting in the rear of the power house of the Buffalo Street Railway Company, it extends for a distance of nearly 4,200 feet north to a point about 300 feet beyond Brace street, where the terminal house will be built. The conduit is formed by twelve vitrified tile ducts, each 3 inches in diameter in the clear. These tiles were made by the H. B. Camp Company of Greentown, O. They are laid in concrete with 4 inches as the minimum protection on all sides. Three of the ducts will be sufficient to carry the cables first laid, but with their usual foresight the Niagara Falls Power Company are making provision in this construction for twelve cables. The depth of the conduit trench is about 40 inches, but this was governed somewhat by the conditions met with, the average depth of the soil covering over the conduit being about 18 inches. In no place does the conduit approach the edge of the canal bank nearer than 14 feet, its inside line holding close to the 16-foot mark.

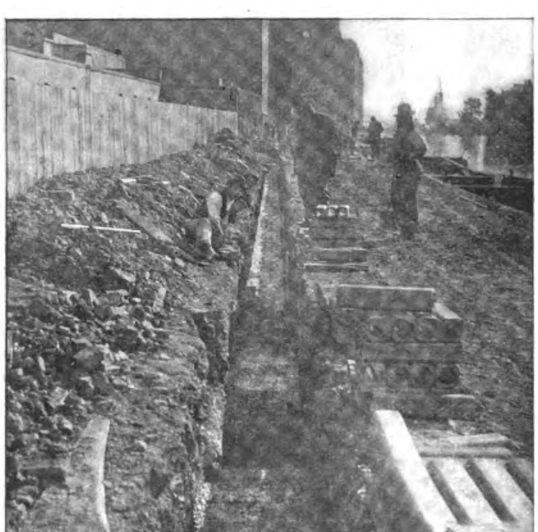
In all, there are about sixteen manholes along the line of the conduit, their location being governed mainly by the condition of the locality. These manholes are octagonal in form, with an interior of 5 feet. They have a brick wall of 12 inches, the bottom being formed by 6 inches of concrete and one layer of brick. In the construction of the conduit the surplus earth was loaded onto scows and carried out into the river and dumped. The terminal house will be of brick, with an interior of 16 by 9 feet and a height of 22 feet. From the last manhole in the conduit to the terminal house there will be a short tunnel about 4 feet long. The anchorages of the cables will be on the poles outside.



The Niagara Falls-Buffalo 20,000 H. P., Three-Phase Transmission Line.



Insulator, Niagara-Buffalo Line.



The Conduit Section along the Canal.

The cable to be laid in the conduit will be lead-covered and furnished by The Safety Insulated Wire and Cable Company, of New York, under strong insulation guarantees. This cable will have a conductor equal to 350,000 c. m., and aggregates 12,345 feet in length for the three circuits. The rubber insulation is 9/32 inch thick, covered with rubber tape. The lead sheath has a thickness of 7/64ths inch, and contains 3 per cent. of tin. Tests of the cable on the ground showed it to be capable of withstanding 40,000 volts without injury. This lead cable will be carried upon a trestle inside the terminal house, where the ends will be sealed, and a rubber insulated wire without lead will be carried out as far as the first pole, the distance probably being about 20 feet, and there it will be connected with the bare copper cable of the pole line. The terminal house will be equipped with lightning protectors.

The transformer house at the Buffalo end of the line will be 16 by 20 feet inside and located in the rear of the Buffalo Railway Company's station. It will be almost entirely below ground, and in it will be placed the static transformers, the rotaries to be located on the power house floor, it is understood. The electrical equipment of this line, it will be recalled, will be supplied by the General Electric Company.

The illustrations presented herewith give an excellent idea of the headway made and of the manner in which the pole line is constructed, but do not show it in its finished state. In securing the right of way over private property many difficulties were encountered, all of which were met and overcome by the remarkable determination and energy of the Niagara Falls Power Company, with the result that the route selected is quite direct in its general line. In some cases farmers were loath to divide their farms by selling a strip 30 feet wide at or near the center, and this forced the line to the bor-

ders of some of the farms, causing some circuitous places, as will be seen by the illustrations. Then, again, the route of the proposed Buffalo, Thousand Islands & Portland Railroad, as well as other railroads, had to be crossed.

The poles are set at a depth of 6½ to 8 feet, and where soft soil was met they were set in concrete. For the main, however, they are placed right in the ground and thoroughly well tamped, the soil being of very hard clay. In fact, it is stated, that the men found the work of excavating for the poles very hard, the clay being exceedingly firm. The poles are set to the east side of the center of the right of way, the outside line of the 30-foot strip being 1 foot beyond the end of the outside line of the large crossarms. The two top crossarms are 12 feet long by 4¾ by 5¾ inches, and made of yellow pine. Both of these crossarms are designed for power conductors. They are supported by braces made of 2 by 2-inch angle iron. The lower or telephone line crossarms are 6 feet long by 3¼ by 4¼ inches. They are supported by 1½ by ¼-inch iron braces. The crossarms are all staggered, the gains being painted before the arms are set. Where double crossarms are used at corners and other angles in the line, they are fastened by ¾ by 10-inch lags and ¾-bolt through all parts. All poles set at angles will be guyed by a ¾-wire strand and turnbuckles to the bottom of the opposite pole.

The line conductors consist of nineteen-strand cables, each of 350,000 c. m., and furnished by the American Electrical Works of Providence, R. I. These are shipped on reels weighing about 2,800 pounds, and containing about half a mile of cable. In connecting the ends the inner core is removed and a half connection made, which is soldered. In stringing the cables the reels are loaded on a cart having wheels of 5 feet 4 inches and a tread of 3 inches. In this way the cable is run out, and the simple movement of a lever brings it up taut on the poles. The poles are all to be painted with two coats of pure white lead and boiled linseed oil. They are set from 60 to 75 feet apart, but the distance is varied in order to overcome the vibrations of the spans. Complete transposition is effected every five miles, and at these five points on the line two poles which are 5 feet higher than the adjacent poles are placed. One of these transposition points is shown in the accompanying illustration, the first two poles showing above the margin of the woods to the left in the picture being a set of the poles referred to.

In turning corners six poles and double crossarms are used in order to distribute the strain of the cables on six instead of three pins. The pinholes have a depth of 4 inches, and all have drainage holes in them. The pins are boiled in linseed oil and their butts are painted. They are not nailed in position until after the double petticoated insulators are screwed on. The upper crossarms are prepared for pins on which galvanized iron barbed wire will be strung at a height of about 18 inches to afford protection from lightning. These wires will be grounded at frequent intervals.

The insulators will be of the triple-petticoat, helmet pattern shown in the engraving. The cable will rest in a groove at the top, and the rim of the helmet will lead the water to the ends, so that the drippings will fall clear of the crossarms. These insulators are designed to withstand a pressure of 40,000 volts.

The expectation is that Niagara power will be sent to Buffalo before the close of November, but it is evident that the power company will not have any great amount of power to send to that city before the wheel-pit extension is finished. Mr. William A. Brackenridge, M. Am. Soc. C. E., chief engineer of the Cataract Construction Company, is in charge of the construction of the transmission line on behalf of the power company, and under his direction the transformer house adjoining the power house is being fitted for the part it is to perform in raising the voltage of the current. The electrical engineers of the world are watching the work at Niagara, and with success of the transmission of power to Buffalo will come another great victory to add to the many that have been scored in this power plant and by the men who own it, and also by those who have it in charge.

THE EARTH A GREAT MAGNET.

In a lecture entitled as above, delivered at Liverpool, Dr. J. A. Fleming considered the question of the nature and origin of terrestrial magnetism and said that if the greater part of the earth's magnetism was due to the materials of which the earth was composed being permanently magnetized, then it was tolerably certain that this magnetic effect was wholly confined to a layer not much more than twelve miles thick. The lecturer concluded by emphasizing the enormous importance of the work which had been done in studying the behavior of the compass in iron ships, and the improvements effected in the compass, chiefly in this century due to Lord Kelvin.

THE ALTERNATING MOTOR FOR FARM WORK.

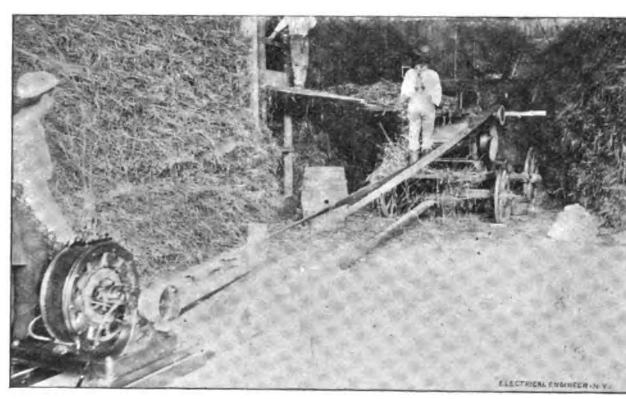
BY ROBERT E. DALLAS.

The Electric Barn.

ALTHOUGH a few attempts have been made at introducing the electric motor in driving farm machinery, these have been uniformly carried out by the aid of direct current motors. The writer has, therefore, deemed it of sufficient interest to describe what he believes to be the first instance of an installation of this nature operated by an alternating current motor.

We have been trying for some time to get hold of a good alternating motor that would start itself, especially on full load. A good practical motor of this description is exactly what we central station men need badly for the development of our business, and the opportunity to run day and night with a full load, which is the only paying load a central station can carry. A successful alternating motor would be of immense advantage to us and to the farming community around us, affording opportunity to furnish a safe and economical power within a radius of ten miles.

I think such a motor has been developed and perfected, with the exception of a few minor points, by Mr. J. J. Wood, of the Fort Wayne Electric Company. We have two of these motors in use here, a 2½ h. p., which is running a printing office on all kinds of work very successfully. The other is a 7½ h. p., installed on a farm about six miles away from our plant, and with which we have very successfully threshed this season's wheat, a crop of 450 bushels, and have also placed ten acres of corn in the farmer's silo. We threshed out the wheat in fifteen hours, a piece of work that it would have taken the ordinary traction engine used for this purpose three days, and



THRESHER DRIVEN BY WOOD ALTERNATING MOTOR, SIX MILES FROM STATION, KENNETT SQUARE, PA.

we filled the silo in ten hours, for which work the engine would have taken the same time as for the wheat, namely, three days.

The farmers seem very well pleased with the operation of the motor, and displayed great interest in watching it in operation, some of their comments being very amusing, indeed.

After being started the motor required absolutely no attention whatever, doing its work easily and noiselessly. Of course, the motor requires to be in step with the machine at the station, but we have no trouble from that cause, as it has only fallen out of step twice, and as all you need to do in that event is to throw over the switch and start it again, it becomes a very simple matter for the most inexperienced person to manage.

One objection to these motors is that they require a tremendous amperage at the start, but as the speed approaches nearer and nearer to synchronism the current decreases until the two are in step, when the current is about the same as the ordinary continuous current motor. Twice on starting this motor with load on, we blew 180 ampere fuses. They come up to speed very fast, however, and will come to synchronous speed in from five to ten seconds. They should, however, be fitted with transformer capacity to start on not less than 1,500 watts

to the horse-power. This 7½ h. p. in actual work with load on uses about 5,500 watts. For all general purposes where alternating current can be procured, I think the work this motor gives would fill the bill very well. Their cost, to begin with, is rather high, but this will decrease as the demand increases. They are easily moved and one motor could be used by several farmers where the current is available. They will surely bring a day business to many an idle central station.

Kennett Square, Pa.

TELEPHONY AND TELEGRAPHY.

THE NEW WESTERN UNION TELEGRAPH OFFICES IN BUFFALO

BY A. C. TERRY.

THE recent removal of the offices of the Western Union Telegraph Company in Buffalo from Brown's Building to the new Ellicott Square Building, has brought into existence one of the finest telegraph offices in the United States, and for convenience, comfort and sanitation, it is thought to be second to none.

The Ellicott Square Building is a model of completeness, and is reputed to be the largest office building in the world. It covers an entire block, and is 200 by 240 feet, and cost, with the land, $3,500,000.

The building is ten stories high, has a court or rotunda 70 feet by 110 feet, and there are over four miles of corridors. There are sixteen elevators, and its electric plant consists of four direct coupled Edison dynamos, three of 100 kilowatts and one of 75 kilowatts, or a total of 375 kilowatts.

In this building the new offices of the Western Union occupy 12,000 square feet of space, which is proportioned as follows: 1,900 square feet in the basement for the linemen's rooms, supply department, messengers' clothes-rooms, and cable room; 2,000 square feet on the first floor corner of Main and Swan streets for the receiving and delivery departments and the offices of the manager and his assistants, and 8,000 square feet on the tenth floor for the general operating room and bookkeeping department.

The wires of the Western Union Company enter the building underground through twenty iron pipes of a size suitable for cables of 100 wires. At present there are but 1,070 wires entering the cable room, in which there is provided a cable terminal board which is made up of six slate boards set 3 feet 6 inches from the floor in an iron frame. Three of the slate boards are placed on one side of the iron frame and the remaining three directly opposite. Each board contains 340 binding posts set in seventeen vertical rows, with twenty binding posts in a row. The underground cable heads are connected to the binding posts by twenty-wire cables, each cable completing one row.

From the opposite boards 100-wire cables are led directly to the main switchboard in the operating room, and all necessary cross-connections and changes in the main lines or loops are made in the cable room instead of at the switchboard.

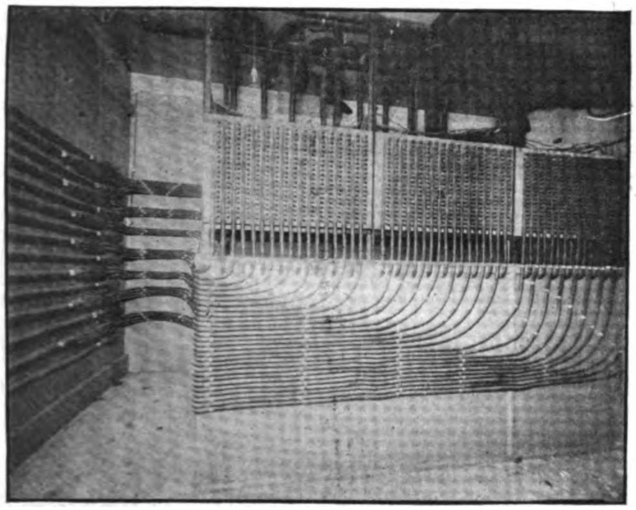
The cables reach the operating room through a shaft 3 feet by 4 feet and 115 feet long, expressly built for the Western Union.

In this shaft are placed fifteen iron pipes, 3 inches inside diameter, through which are pulled the 100-wire cables. The object of the iron pipes is to secure safety from fire. All the main lines and overhead loops are connected to the switchboard through W. B. G. fuses mounted on porcelain blocks. The switchboard is built in six sections of fifty wires each, and the whole is set in a steel frame with plate glass panels. There are 6,000 pounds of steel in the frame. Lamps are used for resistances in the battery leads, and there are 620 of these resistance lamps over the switchboard, or 104 lamps directly over each section.

The operating room is 60 by 105 feet, and the ceiling is 18 feet high. The room is splendidly lighted by twenty-four windows in the side walls and a skylight 35 feet wide and 55 feet

MAIN OPERATING ROOM, NEW WESTERN UNION TELEGRAPH OFFICE, BUFFALO, N. Y.

long, containing thirty-six large sashes of translucent glass which can readily be adjusted for ventilation. Above the translucent glass is the roof of the skylight and the distance from the floor to the top of the skylight is 32 feet. The per-



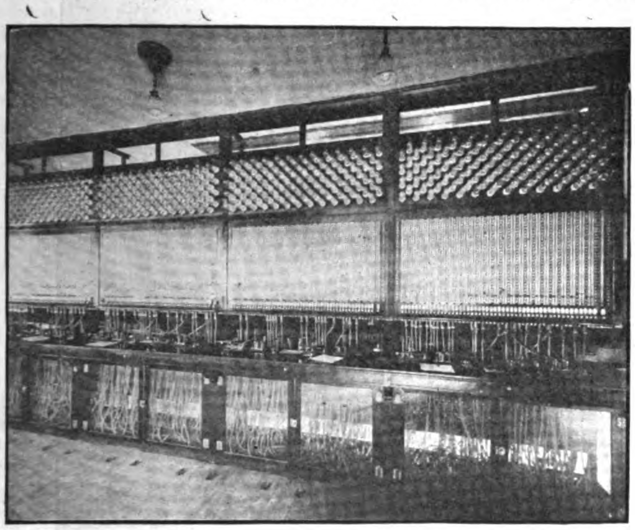
THE CABLE ROOM.

fection of the ventilating arrangements makes it an ideal room from a sanitary point of view.

At night the room is lighted by 150 incandescent lamps.

Ten feet from the switchboard and extending across the room, are four tables 25 feet long and divided into ten sections each. These are for the automatic repeaters. All the other tables in the room are octette, and there are twenty-one of them, with space for six more as facilities demand. All the tables are arranged to accommodate typewriters.

On these tables are distributed 112 single Morse sets, sixty-two sets of duplexes and thirty quadruplex sets, which are connected to the switchboard by four and eight-wire cables laid in 5 x 10-inch wire ways built in the floor, which is constructed of concrete cement and slate. In order to provide



THE MAIN SWITCHBOARD.

for the wire ways the Western Union raised the floor 5 inches above the ordinary level at a cost of $5,000. The wire ways run lengthwise and crosswise of the room, and are covered with slate slabs 12 inches wide and from 2 to 4 feet long.

In the western end of the room is erected a gallery 8 feet wide, 40 feet long and 8 feet from the floor, which is used for distributing and stamping messages. The distributing of messages is accomplished by means of the Martin carrier system, which consists of three lines of elevated tracks, running from the gallery lengthwise through the room and each track has three stations and three carriers. The carriers are connected to an endless rope cable and the whole is operated by two 2 h. p. Crocker-Wheeler motors.

The current to supply the office is generated by sixteen Crocker-Wheeler motor dynamos, ten of which are kept constantly running and giving the following voltages: 6, 20, 80, 160, 240 and 350. The 6-volt and 20-volt machines are for locals and the remaining eight are both positive and negative. It is an interesting fact that before the installation of these motor generators, it was necessary to maintain 17,000 cells of gravity battery, requiring 52,000 square feet of shelving, at an annual expense of over $16,000.

The power current to run the rotary transformers is received from the Ellicott Square dynamo plant. There is also installed a Fort Wayne alternating current rotary transformer, which is operated by current received from one of the Buffalo General Electric Company's 1,000-volt circuits.

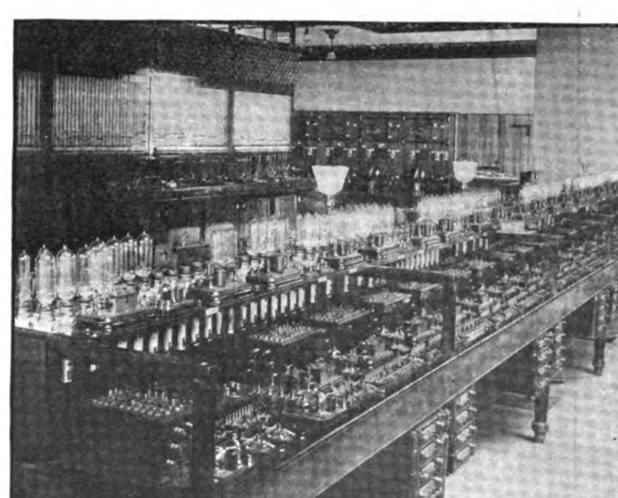
A static converter in the basement transforms the 1,000 volts to 110 alternating and the rotary transformer on the tenth floor transforms to 110 volts direct current. These two sources of current are connected to the motor dynamo bus wires by a

THE MOTOR DYNAMO ROOM.

double-throw switch. In one of the motor generator bus wires is connected one of Cutter I. T. E. single pole underload and and in the other bus wire is a Weston ammeter.
overload circuit breakers, of a capacity of 45 to 125 amperes,

Near the main switchboard is the loop or jack switch having 200 spring jacks. All the multiple sets and single repeaters are connected to this switch, so that it is possible to make up repeaters of any two multiple sets in the office, or from any multiple set to any single repeater.

The repeater system of the Buffalo office is the most extensive of any on the continent, and during the storm of September 30, along the Atlantic coast, no less than thirty-five multiplex circuits were repeated at Buffalo; and this, not including



THE AUTOMATIC REPEATERS.

three Wheatstone automatic circuits between New York and Chicago on which on the first day of the storm 10,000 messages were transmitted in ten hours.

The local business of the office is transferred from the oper-

ating room to the receiving and delivery departments by means of pneumatic tubes and a drop tube. The pneumatic tubes are 150 feet long and are operated by a steam jet. The message pouches or boxes require eight to ten seconds in transit.

The drop tube to the delivery department, which is 6 inches in diameter, has just sufficient exhaust by means of the steam jet to keep up a downward current of air. No message boxes or pouches are used in this tube.

The planning of the office was left entirely in the hands of the Buffalo management, subject to the approval of General Eckert, president of the Western Union, and Mr. A. S. Brown, electrical engineer to the Western Union, and the equipment of the office was in charge of Frank Kitton, chief operator, and A. C. Terry, assistant chief operator.

ELECTRIC TRANSPORTATION.

STORAGE BATTERIES IN USE BY THE UNION TRACTION CO., PHILADELPHIA.

THE most recent and most important step thus far taken in the United States in the application of the storage battery to electric railway work is embodied in the installation just completed by the Electric Storage Battery Company for the Union Traction Company of Philadelphia.

The plant under consideration is situated at the end of a feeder, eleven miles long. This year it was decided to extend the line several miles, and it was found that it would be necessary either to build a new power house or install a battery substation, as the required addition to the existing feeder system would necessitate such an enormous outlay for copper as to render it commercially impossible. It was found that the cost of copper alone, to carry out this extension and double the service on the section, would be four or five times the total cost of a battery installation to fully meet all the requirements; and that a new power house was out of the question on account of the heavy operating expenses.

Before the extension was made the pressure at the end of **the feeder was barely enough to operate cars on schedule time, and the pressure varied as much as 50 per cent. The recording voltmeter chart, Fig. 1, illustrates the effect of the battery**

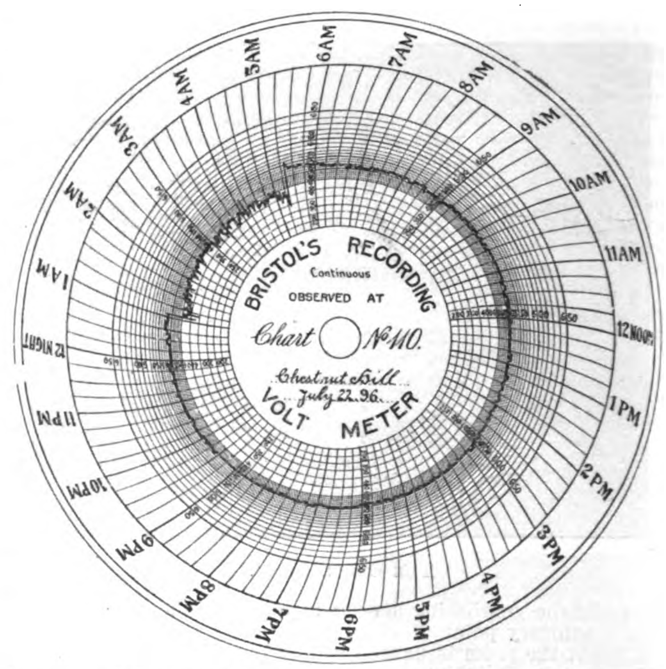


FIG. 1.—CHART SHOWING POTENTIAL ON RAILWAY FEEDER CONNECTED TO STORAGE BATTERIES.

as a regulator of pressure. During the four hours between 1 a. m. and 5 a. m., the only time when the battery is taken off the system, the fluctuation in pressure is very marked.

The current curve taken on the line shows that the battery

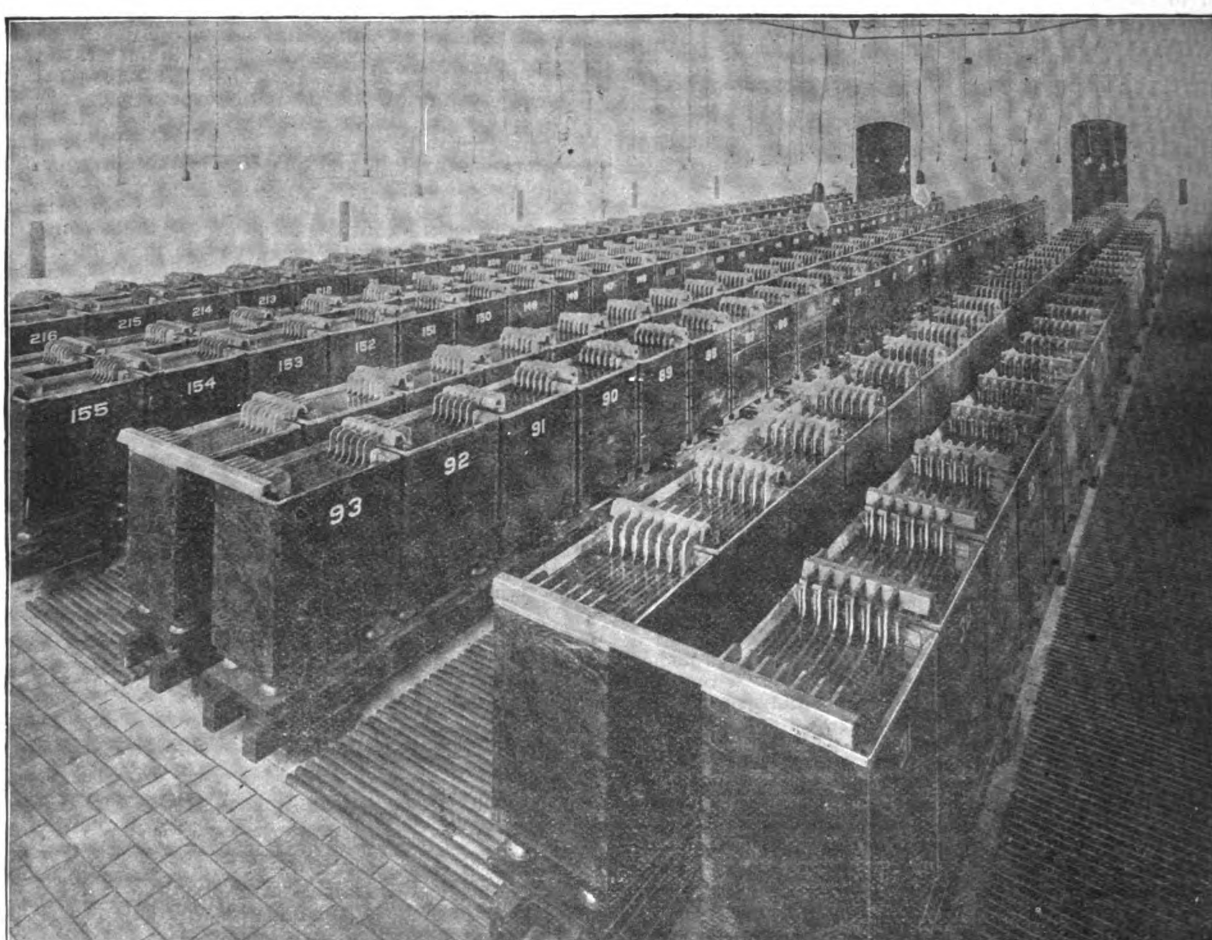


FIG. 2.—VIEW IN STORAGE BATTERY ROOM, UNION TRACTION CO., PHILADELPHIA, PA.

regulates to the extent of 200 horse-power; but it can be worked up to 800 horse-power in cases of necessity. The load on the section varies from 100 to 700 amperes; the feeder carries a constant load of 400 amperes, the battery discharging or charging to the extent necessary to maintain this condition. The result in actual practice is found to be that the feeder load remains constant at this average current and is absolutely independent of the fluctuating demand on the line.

Fig. 2 shows the battery house in which 248 cells are installed. Each cell contains thirteen plates, type "G," of the Electric Storage Battery Company's Chloride accumulator. The maximum discharge rate of the battery is 400 h. p. for one hour. The plates are contained in lead-lined boxes, mounted on two tiers of oil insulators. The connections are made by continuous weld, no mechanical contacts being used throughout the battery.

The Electric Storage Battery Company are at the present time installing several battery plants in street railway power houses. The battery in these cases enables the generators always to run at full load, and, consequently, at the highest point of efficiency, and to act as a cushion to the engine in the event of the circuit breaker opening when trouble occurs on the line.

PRESIDENT LITTELL ON THE STREET RAILWAY SITUATION.[1]

AMONG the most serious difficulties with which we have to contend to-day is the growing disposition of the government, whether State or municipal, to increase our burden of taxation. This disposition has increased of late years, and even within the last year, to a marked degree. The extraordinary prejudice against corporations, among people otherwise intelligent, causes them to be regarded as legitimate objects of attack and spoliation. Those who have once become affected with this prejudice seem to be unable to understand that a corporation is simply a collection of persons, by means of which individual resources, which would otherwise be frittered away in individual enterprises, are brought under one direction, making possible the success of large undertakings requiring an aggregation of capital. Of all corporations those which suffer most from this prejudice are those which exercise a public franchise, and the street railway franchise seems in particular to be a favorite object of restrictive legislation. With the arbitrary limitation of the rates of fare and the obligation of conforming the roadbed to every change in the street through which it passes, on the one hand, and the imposition of direct burdens of taxation in the way of personal taxes, taxes on roadbed, license taxes, franchise taxes, taxes on gross earnings and taxes on dividends, on the other hand, the financial limits within which the workings of a railroad are confined have become exceedingly narrow. Sometimes it almost seems as if the legislative agencies in our various States would not stop until they had brought the burden of taxation to a point where roads could no longer run.

For such a state of things it seems to me that the only remedy is to be found in that gradual enlightenment of the public, by which it will be induced to keep the imposition of financial burdens within reasonable bounds, and such a broad-minded and conciliatory management of the roads as shall in time do away with the last vestige of popular prejudice. Any successful business corporation manages and controls forces far greater than those which are at the command of a single individual, and its very power makes it an object of jealousy and attack. But I for one do not believe that the intelligence of the American people will in the long run go astray on this question any more than on any other. I believe that it is beginning to recognize, and will recognize still more clearly as time goes on, the necessity for combination and co-operation in all departments of business; and that if a proper spirit of moderation is shown—and this I consider of the first importance—by those in whose hands this extraordinary power is placed, the community at large will discover that the benefits which it derives from transportation corporations far exceed any subject of complaint which it may have against them, and will meet them upon the footing of a common interest without regard to the corporate character of the agency by which the power is exercised.

Another, and one of the severest strains to which street railway corporations are subjected, consists in the penalties imposed by courts, for the negligence of their employés. Recent years, and especially the last two years, have seen a great increase in the number of negligence suits and in the size of verdicts. There is a marked tendency at the present time, on the part of juries, to fix a higher scale in estimating damages for personal injuries. Cases where formerly verdicts of $2,500 were rendered, now often result in a judgment for $5,000, and others in like proportion. The State of New York has recently removed the limit of $5,000 in cases of death, so that now a verdict of $20,000 in a death case is by no means unusual. The doctrine of contributory negligence, which in theory and as duly expounded by the courts, in charges to juries, would preclude any recovery in cases where it is shown, seems only to be considered by juries—if considered at all—as a slight makeweight against the plaintiff in determining the amount of damages. Probably no class of cases exist in which it is so difficult to meet false testimony as in these, even when its falsity is perfectly apparent.

I do not mean to suggest for a moment that street railway companies are without fault in the matter of accidental injuries, but I do say that, profoundly as we must sympathize with the suffering and the unfortunate, we ought not to be compelled to pay the penalties of negligence where the negligence was due to the sufferer himself, nor should a case be sent to a jury where this fact is disclosed by the plaintiff's own statement. As well said some time ago by the General Term of the Superior Court of New York: "To leave it to a jury to say that such acts under such circumstances do not constitute negligence, would be to throw away the best understood legal standing, and substitute in its place any whim which might chance to flit through the minds or run in the emotions of uninstructed and unbridled jurors."

Whatever may be the ultimate result of existing tendencies in courts and juries, we may still hope for improvement in the matter of accidents, as people become more accustomed to the high rate of speed in their streets, which they now exact from street railways. No community which has had the benefit of rapid street transportation would ever be willing to go back to the old 5 or 6-mile-an-hour rate of horse cars. It must learn and it will learn it cannot have this benefit without a certain element of danger, and whether it runs the risk of this danger in traveling as passengers on the cars or in walking or driving in the roadway, it will come in time to take those precautions by which the great majority of accidents could readily be avoided.

For those accidents which no ordinary precaution on the part of the sufferer could avert, I believe there is one remedy and only one, and that lies in the hands of the management of street railways. That remedy is to be found in the discipline of the force. If discipline is slack, accidents will be frequent. If discipline is high and well maintained, accidents will be reduced to a minimum. As in every other great organization, the spirit which controls at the top penetrates through all the branches of the system, and the means by which it penetrates is the discipline maintained over the force by its head. In this one element of discipline I believe lies the secret of preventing the ruinous losses which follow from damage suits.

The last two years have seen the introduction of an unlooked for competitor in street, and especially in suburban transportation, and that is the bicycle. In some places where its use is peculiarly advantageous, it has undoubtedly cut down earnings very heavily. I do not believe, however, that in the long run the street railway business is going to suffer on that account. Anything to my mind that promotes in our American people the habit of locomotion, particularly of rapid locomotion, is beneficial to street railways. No doubt the bicycle has come to stay, and no doubt upon some suburban routes its competition has been serious, but it is still to a great extent a novelty, and when the effects of novelty have worn off, and the use of the bicycle is limited to those who will habitually make use of it all their lives, I think there will still be found quite enough people who prefer street cars as a means of locomotion, even in places where the bicycle can be used.

In spite of the disadvantages of which I have spoken, under which street railways suffer, and in spite of the financial difficulties which have prevailed for the last three years, and which have told as heavily upon street railways as upon any other interest, I believe they have before them a bright and prosperous future. In their prosperity every man, woman and child in our city communities, and in many rural districts, is directly interested. They have been of enormous benefit in spreading out populations over a larger area, in relieving densely populated districts in cities, and in making possible suburban homes, where the man who pursues his business in the heart of the city can live with his family at a distance from his office, and with them enjoy the benefits of space, of sunlight, of fresh air, of trees and gardens and of rural surroundings. This is especially true of the more modern forms of rapid transportation by which the time of transit is reduced. The luxury of such a home as I have described, to those of moderate means, who hitherto have been crowded into small and unwholesome flats or tenements, is one of the many blessings which the modern street railway has bestowed upon the

[1] Abstract of Adress Delivered at St. Louis Oct. 20, 1896.

community, and those who have reaped the benefits of it are not likely to forget it.

In conclusion, I desire to congratulate the association upon the large number of its members who are present here to-day, and to express the hope, in which I am sure all of you will join me, that this meeting will be the most harmonious, as well as the most interesting, that we have ever held.

THE MODERN POWER HOUSE.[1]—I.

BY RICHARD MCCULLOCH, COMMITTEE.

IN beginning a paper of this kind, it is usually considered proper to start with a sort of historical review, but in this case we are immediately struck with the fact that, unlike most modern institutions, the eventful history of the street railway power house has been condensed into the last few years. The conditions, the general design and the greater part of the machinery itself, have been evolved during the last ten years. All of these have changed rapidly and the manager who now deplores as antiquated a power house built six years ago, with the best existing machinery and in the light of the most approved practice, can say with Cicero, that it was not his fault, but the fault of the times.

It may be readily seen that there are two standpoints from which the design of the power house may be viewed. That of the one, who strives that the general plan, that each machine and that every arrangement shall tend solely toward the cheapest possible production of power; and that of the other who, while appreciating the position of the former, desires also that nothing shall enter into the design which will materially affect either the simplicity or the reliability of the plant. The cost of power on a large road is about 10 per cent of the total operating expenses, and it is almost a self-evident fact that the use of any apparatus which might produce unreliable service and thus impair the receipts and ruin the prestige of the road in order to save a small percentage of this cost of power would be very bad business policy. The first criterion of any machine installed in a power house should be absolute reliability, and the second, economy.

LOCATION.

A great deal has lately been written concerning the proper location of power houses and formulæ and graphical methods for determining this point have been derived, but we doubt very much whether any street railway power house has ever been located either by graphics or by the differential calculus. Unfortunately it usually happens, especially in cities, that the electrical center of the distribution system falls in very valuable ground entirely unsuited for a power house location and the final location is very often influenced by the extremely unscientific fact that the railroad company owns that particular piece of ground and cannot find a purchaser for it. In selecting a location, it is very important that a large power house should be placed on a railroad track so that coal may be readily and cheaply delivered, and it is very desirable that the location should be on some water supply in order that condensing engines may be used, unless the conditions will warrant the use of self-cooling condensers. If a location fulfilling these conditions can be found somewhere near the electrical center of distribution it is an ideal spot for a power house, but if in order to secure coal and water it must be moved from this point it should if possible be moved in the direction of future extensions of the street railroads. There are cases where power houses cannot be located on the steam railroad tracks, but the only excuse for such a location is where the interest on the cost of copper feeders running from the steam railroad tracks to the center of distribution would greatly exceed the cost of hauling of coal in wagons.

BUILDING.

The main points which should be borne in mind in the design of the building are that it should be light, airy, compact and fireproof. The shape and size of the building will be largely governed by local conditions, but there is one general arrangement which has been adopted in a number of the most recent power houses. This will be discussed later. There is no reason why anything combustible should enter into the construction of a power house. The walls may be of brick, the roof of slate, tile or iron, and the floors of concrete or iron. This method of construction not only increases security against fire, but it obviates the necessity of carrying insurance, the saving of which will in a few years pay the extra first cost. The building should be substantially constructed, but unless the location is on an important street there is no necessity of going to great expense to render the building ornamental, especially as all money which can be spared for this purpose may be far better invested in machinery to put inside the building. In erecting a building for use as a power house it is advisable to decide first on the style, size and arrangement of the machinery, so that no part of the building will interfere with the proper repairs, renewals and inspection of the apparatus. This may seem unnecessary advice, but it is a very common oversight for railroad companies first to decide on the style of building they wish, then let the contract for the erection of the power building, and then find themselves hampered in the use of some particularly desirable form of apparatus by the shape or contracted area of their buildings.

As by far the greater number of the modern railway power stations are operated by steam power, steam alone will be considered in this article. For convenience in discussion the apparatus in a power station may be divided in three classes: (1) The steam generating part consisting of the boilers, pipes and all their accessories, such as coal and ash conveyors, mechanical stokers, stacks, economizers, feed-water heaters, pumps, etc.; (2) the steam consuming part consisting of the engines, steam separators, oiling devices, condensers, etc.; (3) the electric part consisting of the dynamo, cables, switchboard, electrical instruments, etc. The division betwen the first and second parts is more easy and more marked, as it is usually accentuated in the power house itself by means of a brick wall.

STEAM GENERATING APPARATUS.

Beginning with what we have called the first part, we start with the choice of fuel. This is largely a matter of location. In a general way the proper fuel to use is that which will evaporate the greatest quantity of water per dollar's worth of fuel. It does not pay to burn too poor a quality of fuel, however, because slack containing a great quantity of ash and sulphur will cake and clinker on the grate bars, make a great deal of work for the firemen, refuse to be forced when necessary and make much ash to be removed. On the other hand, it will not do to make all arrangements for using a very expensive fuel, as a very little wasted in times when the furnaces must be rushed will make a great difference in the cost of operation. As an expensive fuel usually means one which is brought from a great distance, any furnace prepared for burning this would operate under unfavorable conditions if the supply is cut short by strikes or railroad blockades. Where the conditions are favorable for the use of oil, it makes an ideal fuel, requiring no handling, making no smoke or ashes, and allowing the fire to be regulated with the utmost nicety. Buckwheat anthracite coal is used largely by power houses in the Eastern cities. It is of high calorific value, clean, making no smoke and little ash, and capable of being readily handled in coal conveyors and mechanical stokers. In the western cities soft, bituminous coal is used by force of necessity. This brings with it the troubles of ash, clinker and dirt, and in the city renders necessary some form of smoke consumer. As has been stated, it usually happens that the choice of fuel is a matter of location, but in cities where several competing grades of coal come to market, it would probably pay to have expert tests made to determine what grade of coal or what mixture is most economical for the work.

It is hardly within the limited scope of this article to discuss the numerous forms of coal and ash conveyors which have been put in use. Several large companies make a specialty of this form of machinery and special designs are developed for each power house. We may say in a general way, that in power houses handling large quantities of coal, where the coal is all delivered at the same place, as by rail or boat, the installation of coal and ash handling machinery will pay. Where coal is delivered in small quantities and where it is delivered in wagons and may be dumped at any part of the boiler room, the reverse may be said. The advantage of this form of apparatus is its saving in labor, and its disadvantages are its great first cost, its expensive maintenance and the fact that it is desirable for the best service that the coal should be fairly uniform in size, which is a requirement not always easily fulfilled.

In the East the use of mechanical stokers has grown to such an extent that no large power house is considered complete without them. In most of the Western cities, however, and especially here in St. Louis, the mechanical stoker has not been a success. This difference in results may be attributed to the difference in the fuels used. The buckwheat coal of Brooklyn and Philadelphia feeds evenly on the stoker and causes no trouble by cementing the grate bars together by clinkers. With the soft, fragile, bituminous coal, however, clinkers soon form on the grate bars, and very often the fire must be almost completely destroyed to remove them. No mechanical stoker will bear crowding to any great extent and any power house using them must be supplied with a greater capacity of boilers than

[1] Paper read before the Amer. St. R'way Assoc., St. Louis, Oct. 19-23.

one where hand firing is the practice. By reason of the fact that the coal is introduced gradually into the hotter part of the fire and the volatile matter slowly driven off, a mechanical stoker is a partial smoke consumer. With the exception of this, there is no advantage in the use of mechanical stokers, except the labor saved, as the great efficiency which was formerly claimed for them has never been proved in actual practice.

Notwithstanding the great number of types of boilers on the market, they may be divided into two general classes—fire tube and water tube. In most of the more recent power houses, some form of water tube boiler has been adopted, as this type possesses some marked advantages over the fire tube. They are non-explosive, they can be operated at a higher pressure and consequently are more suitable for use with compound engines, they have a large heating surface and are quick to respond to calls for power, they occupy less floor space and are usually more intelligently designed than the other class. On the other hand, their first cost is greater, there is a greater number of joints to be looked after and the cleaning is more difficult, especially in those forms which use a curved tube. It has usually been considered that the efficiency of water tube boilers was much higher than the fire tube, but there is now a form of fire tube boiler being made consisting of a shell of large diameter and extra length, containing a large number of flues, which approaches the water tube very closely in efficiency. The high efficiencies obtained in boiler tests are seldom reached in actual practice as they usually result not so much from excellence of design in the boiler itself as from careful and intelligent firing during the test.

It is hardly necessary in presenting a paper before this intelligent body to discuss the reasons why water should be fed into the boilers as hot as possible. Besides preventing the straining of the boiler shell from the sudden changes in temperature, there is a large quantity of fuel saved, and the percentage of this saving will be found tabulated in nearly every work on thermodynamics. The usual methods employed in heating the feed-water are, first, by the heat of the exhaust steam, and, second, by the heat of the escaping flue gases. There are numerous patented devices for utilizing the heat of exhaust steam either by passing the exhaust through a number of pipes surrounded by the feed-water, or by spraying the feed-water across an opening through which the exhaust steam is admitted. Most of these devices are very simple in their construction and their efficiency depends very largely on the length of time the feed-water and the exhaust steam are in contact, and in case they are in separate chambers upon the conductivity of the separating medium. Care should be taken that the opening for the exhaust steam is never contracted, so that any possible back pressure on the engine is avoided.

The method of heating feed-water by the heat of the escaping flue gases has been applied in apparatus under the general name of economizers. The arrangement usually employed is a coil of pipe containing the feed-water placed in the flue. In order to keep the soot from settling on the pipes, most forms of economizers are supplied with a mechanism for scraping off the pipes whenever necessary. Sometimes the economizer consists of one large bank of pipes placed in the main flue, and sometimes the apparatus is divided into a number of banks placed in a flue leading to one furnace. The choice of arrangements depends largely upon the size of the plant and the general location of the boilers. By means of a properly designed economizer, feed-water may be heated to a very high temperature, even above the atmospheric boiling point of water. In the use of any device in which feed-water is heated by the flue gases, care should be taken that the escaping gases will still retain sufficient heat for the maintenance of the necessary draft after part of their heat is taken from them by the feed-water. In the case of power houses using natural draft, economizers should not be used, where the draft is not already sufficiently strong, or is just barely strong enough for the work to be done. There are in operation, however, many plants using natural draft, discharging flue gases at a very high temperature, much higher than is necessary to maintain the required draft. Economizers used in such cases would result in a marked gain in economy.

Whatever system of heating feedwater is used, the apparatus should be made abundantly large for the work to be done; first, that the water should pass through slowly and receive the full benefit of its contact with the heated gas or steam; second, that a large store of water may be kept on hand which is of great service in case of a sudden demand on the boilers, and, third, that the feed-water heating apparatus may act as a water purifier. It has been found that water kept for some time at a high temperature will deposit a great portion of the carbonates and sulphates of lime and magnesia which it has in solution. This is probably due to the expulsion by the heat of the carbonic acid gas contained in the water, thus freeing from solution the lime and magnesia which it is well known are slightly soluble in water containing carbonic acid gas.

With condensing plants the waste from the condensers is never at a greater temperature than 100 degrees F. and if hot feed-water is desired the use of an economizer becomes almost a matter of necessity, as the water from the pumps and the other non-condensing machinery would not have sufficient effect in heating the feed-water of a large plant.

Several of the large power houses built during the last few years have abandoned the use of stacks for producing draught, and are operating by means of an induced draft produced by fans placed in the flue or short stack. In this case the stack is just high enough to clear the roof. This system has many advantages. First, there are no stacks to blow down or fall down, and this point is of special importance in a region subject to tornadoes. The second and most important advantage, however, is the absolute control which it affords in governing the fires, and this point will appeal especially to those power houses subject to sudden and rapidly changing loads. As an illustration of this may be cited the power house recently erected to operate the Belt Line tunnel road, in Baltimore, Md. A great part of the time there is no load on the power house, as it is only operated when there is a freight train to be hauled through the tunnel. The manner in which the load is handled is as follows: The boiler room is supplied with blowers in place of stacks, and a slow fire is kept constantly under each boiler. When a telegram is received that a freight train is approaching, the blower is started and on the arrival of the train, steam has been raised in sufficient quantity to supply the great demand put upon the boilers. This illustrates the extreme flexibility of the system and it would be difficult to handle this load in any other manner. Economizers are operated with great efficiency in connection with an induced draft as this system permits the flue gases to be robbed almost entirely of their heat, since it is not necessary to have a large quantity of heat in the flue gases in order to create a proper draft.

Passing from the steam generating system to the engines, we find as a connecting link, the system of piping. In regard to the general plan of the piping, opinion is very much divided. Some favor a single header with leaders to the engines. Others claim that a complete duplicate system is necessary, so that a failure in any part of the system need not cause a serious stoppage. The objection to a duplicate system is the greatly increased cost. In the installation of a duplicate system, it is only human that the material and workmanship employed will be cheaper than if a single system were employed, because it is reasoned that if one side breaks down, there is always the other to be depended upon. The other side, however, is often never used until a case of necessity arises, and on account of this very lack of use, the valves and joints are apt to be found leaky and in bad condition when suddenly put in operation. A compromise system has been used in some cases in which all pipes are duplicated, each side, however, having one-half the capacity required, necessitating the use of both sides at all times. In case of accident to one side, the other half of the system may be used, at a disadvantage, of course, by increasing the steam pressure. The best plan, however, seems to be to use a single header divided at convenient intervals by valves according to the size of the plant and the number of units employed, and in laying out the system to use only the best valves, material and workmanship. The power houses having the least amount of trouble with their piping are those having a simple system, probably because it is natural to erect better, and take better care of something which is in constant use, than something which may easily be dispensed with. All steam and hot water pipes should be covered so as to prevent as much as possible loss of heat by radiation and consequent condensation of the steam. And in this connection it should be noted that there is a great difference in efficiency in the different kinds of pipe covering. Tests have shown that the magnesia plastic and sectional coverings and the asbestos fire felt covering give the best results.[1] A water separator should be placed in the leader to each engine. It should be large in size, and placed as close as possible to the engine. A number of patented separators are on the market, but very good results may be obtained by the use of a simple, large tank with the steam entering at the side and leaving at the top and supplied at the bottom with a connection to a steam trap to catch any water collecting in the separator.

OHIO. The County Commissioners of Crawford County granted to W. E. Haycox, president of the Fulton Truck & Foundry Company, of Mansfield, Ohio, and Fred. B. Perkins, of Toledo, the right to construct and operate and maintain an electric road from Bucyrus to Galion. Work will be commenced in the early spring. All business pertaining to said road will be referred to W. E. Haycox.

[1] Journal of the Association of Engineering Societies, Jan., 1895.

TRACK AND TRACK JOINTS, CONSTRUCTION, MAINTENANCE AND BONDING.[1]

BY M. K. BOWEN.

AFTER signing a contract to tell my associates in business how to construct and maintain a street railway track, I began to cast around for data bearing upon the subject, and found that the life of a rail was measured by the wearing out of the head, and less than 12 per cent. was worn away before we sold the old rail for scrap; hence the deduction that the point of contact between the wheel and the rail, in other words, the bearing and wearing part of the track, was the most important consideration. I asked a wheel manufacturer why wheels of street railroad cars were made conical or beveled shaped instead of flat. His answer was, "To draw out of the mold of course." Not being satisfied, I asked a steam railroad man the same question. He said it was for the purpose of compensating on curves for the further travel of the outside wheel.

If I had asked a street railroad man the same question, he would have promptly and correctly answered (even if he did not know and had to guess) that the bevel on a car wheel was for the purpose of centering the car on the track, providing a means for a lagging wheel to catch up again, maintaining the axles of the car at right angles with the rail of track. The foundry man was wrong, because we all know that flat wheels can be made. The steam railroad man, when he answered, had in mind his 10 degree maximum curve, but in applying his answer to our conditions he was wrong, because on a quarter circle curve of 50 feet radius, 30-inch wheels, the outside wheel is compelled to travel 7 feet 4¾ in. farther than the inside wheel, and the absurdity of the bevel of ¼-inch on a two-inch tread compensating for this travel, and preventing slipping is readily apparent, as it would require a bevel of 1 11-16 inches in a two-inch tread to compensate for the difference in travel of the wheels. The effect of the slipping of wheels on curves is clearly shown by the brightness of the rails, showing abnormal wear.

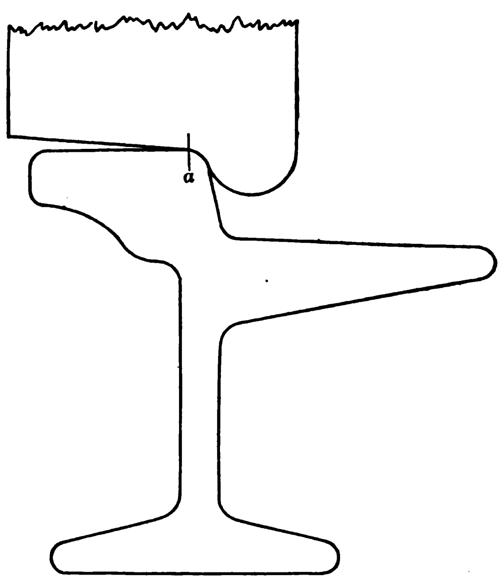


FIG. 1.

Take first a conical wheel running on a rail the surface of which is level. Referring to Fig. 1 we note that the rail and wheel make contact only at the point shown at (a). This is the state of affairs when the rail and wheel are new. In a few months, if we again examine our wheel and rail, we will not find them the same as when we first looked at them. We now observe that the wheel is badly worn next to the flange, while the inner edge of the head of the rail has flattened to a considerable extent and worn down. Both the wheel and the rail are doing their best to come to a common bearing surface, but it is at the expense of scrap wheels, of which only half of the tread has been worn through the chill. It is quite plain that the rate of wear must be enormous at first for the whole weight of the car is brought to bear upon a very small surface at almost a point I might say. This rate of wear steadily decreases as the surface of the rails and wheels wear themselves away until the contact between the two is a line the whole width of the rail, and not merely a point. But long before the surface of the rail has conformed to the surface of the wheel tread, where the best form is attained, the head of the rail has lost a large percentage of the metal allowed for wear, and as wheels wear faster than rails, it has taken in some cases thousands of quickly worn out wheels to bring the rail to its final and best form.

Figs. 2 and 3 show sections of the rail now in use on the State street, Chicago, cable line, the height of the head being 1 3-16 in. The first rail put in State street, Chicago, had a head ¾ in. high; this was increased to 1 in., and later to 1 3-16 in.; it is beveled to conform with the bevel of the car wheel for ⅔ of its section from gauge line across head.

Many will ask, no doubt, if there is not a slipping of the wheels on the rails, due to the unequal diameter of the wheel at all points. There is, imagining the wheel divided into three parts at right angles to its axis (Fig. 2) and each piece free to move by itself, and whose diameters are situated at (a), (b) and (c), respectively, it is quite evident that as the portion (a) makes one revolution it will travel over a less distance than the portion (b) would, and similarly the portion (c) will travel farther than the portion (b) in one revolution, but on account of it being all one the portion (a) travels farther than it otherwise would, thereby causing it to slip; the portion (c) would travel a less distance than it otherwise would, thereby causing it also to slip.

The above is based on the supposition that the car would move a distance equal to the circumference of the wheel at the point (b) in one revolution of the wheel. But this waste of power due to slipping is very slight, for, considering the coefficient of friction as .15, we find that for a ton mile the energy lost by this slipping is .0104 horse-power; so small in fact, that on account of other advantages it may be ignored.

The experience of the Chicago City Railway Company, who first tried this form of head, has been that it saved wear of both rails and wheels, increasing their life by about 35 per cent. Why not in building a track put in rails which are beveled to conform to that of the car wheel at the first, and not spend time and money wearing the wheel and rail down to fit each other?

The question concerning the composition of the rails is one to be considered here also. How does the composition affect the life of the rail? The number of starts and stops made by cars on electric railways are enormous as compared with those on a steam road. The result is the wheels slide, sometimes spin, and this, together with the sand and dirt on the track is a cause of great wear on both the wheels and rails. This wear, together with that due to other causes, might be greatly reduced by proper composition of metal.

I give below a table gathered from different sources showing the composition of metal advocated by experts to-day:

	A.	B.	C.	D.
Carbon	.45- .55	.55- .60	.50	.40
Manganese	.80-1.00	.80-1.00	.75-.95	.01
Phosphorus	.06 not over.	.06 not over.	.09	.11
Silicon	.15- .20	.15- .20	.10	
Sulphur	.07 not over.	.05 not over.	.07	.06

Rail.	Carbon.	Phosphorus.	Silicon.
70-pound Tee	.43—.51	.085	.10
75-pound "	.45—.53	.085	.10
80-pound "	.48—.56	.085	.10
90-pound "	.55—.63	.085	.10
100-pound "	.62—.70	.085	.10

It would seem that the harder a rail becomes through its composition and the process of rolling, the longer it would wear. As regards this, Mr. Moxham of the Johnson Company says: "There are two schools—First, those who advocate a low hardened and ductile material as being of the greater wear. Second, those who advocate the greatest possible hardness, regardless of brittleness. For many years without taking positive grounds, I have leaned to the former class, but the experiments so far made have demonstrated to me that neither class is correct—that the correct solution lies between the two."

I come now to what has been heretofore the weakest part of track construction, namely, joints. What we want is some method of keeping the rails from pulling apart at the joints, due to contraction and spreading outward at joints, and the shape, due to the outward pressure, of the car wheels, and from bending down at the joints, due to the pounding and weight of the cars. The joint I have used for the past year is a cast welded joint. This has been found to give perfect satisfaction as a joint; it is strong and substantial, as has been proven by its holding under the extreme changes in tem-

[1] Paper read before the American Street Railway Association, St. Louis, Oct. 20-23, 1896.—Abstract.

perature for which Chicago is noted. Seventeen thousand joints were put in in 1895, and of those only 154 joints were lost. The joint in comparative tests has been shown to be far stronger than the rail itself, and such breakages as have occurred were due to a flaw in the metal. The metal cast around the joint has eight times the cross section area that the rail has. Hence, considering steel as four times as strong as cast iron, the joint is twice as strong as the rail.

It has been found in some cases where this joint was used

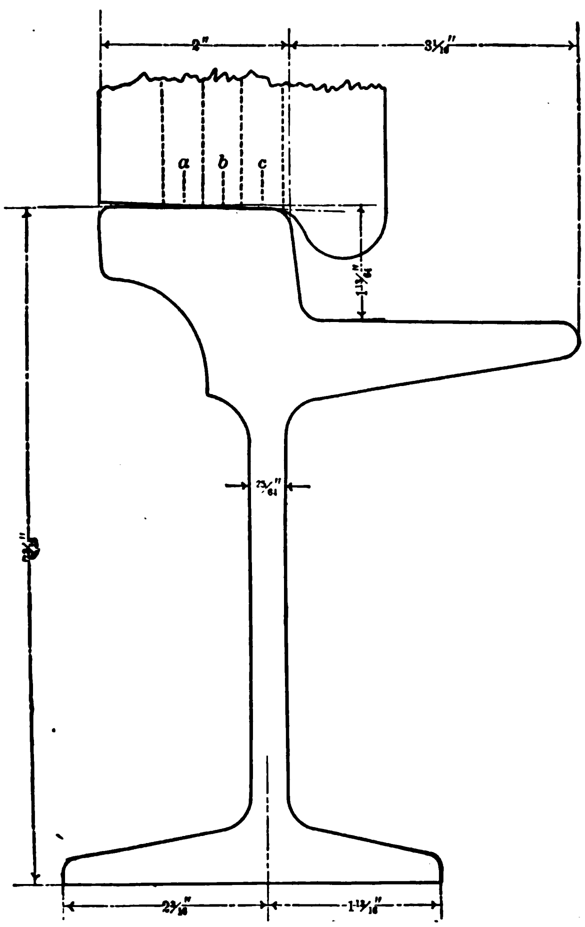


FIG. 2.

at crossings with other tracks, the tracks were apt to be pulled out of shape through the changes of temperature. To overcome this the joint nearest the crossing should be anchored in a substantial manner. The method of making the joint is as follows: The rails at the joint are scraped and brightened, a cast iron mold is placed around the joint, making a tight fit; into this the molten iron, 25 per cent. scrap, 25 per cent. soft and 50 per cent. hard silicon pig is poured. The metal in contact with the mould begins to cool and forms a crust while the interior remains molten. This crust continues to cool and at the same time contracts, forcing the moulten metal strongly towards the center, which makes a solid and rigid joint. The top, or bearing part of the ball of the rail is afterwards filed off perfectly level so that it is very difficult to detect a joint by riding over it or looking for it. Upon breaking a joint which has been well cast, three spots will usually be found where amalgamation has taken place between the rail and cast portion; one on each side of the web and the other on the bottom. These spots are from 1½ in. to 2 in. in diameter. There has been some discussion as to its being a bond for carrying electric current. I cannot recommend it with certainty, as there are occasional joints which I have taken off where no amalgamation has taken place whatsoever, thus destroying the effect as a bond of all joints in that line of track. To overcome this difficulty I have adopted the plan of bonding all joints. However, future experiments and care in the casting of joints may develop their efficiency as a bond.

Fig. 4 shows a section of the track construction used by the Chicago City Railway Company.

The cost of one mile of double track with paving for 18 feet in width of right-of-way, as above specified, based on Chicago prices, would be as follows:

283 L. tons 9 in. rails, 90 pounds, at $33.00	$9,339
4,224 white oak ties, 5 in. x 8 in. x 7 ft., at 38c	1,605
352 cast welded joints, at $3.50	1,232
1,760 tie rods, at 15c	264
33,792 spikes, ½x½x4½, at 1c	338
42,240 ft. of wood filler, at ½c	2,112
Labor at $1 per l. ft. of D. B. T.	5,280
10,560 sq. yds. cedar block, 30c	3,163
146 sq. yds. sand, at $1.25	183
445 cu. yds. crushed stone, at $1.50	668
10,560 sq. yds. gravel and dressing, at 8c	845
10,560 sq. yds. Hemlock boards, 2 in. thick, at 8c. sq. yd.	845
	$25,879

If granite had been used instead of wood block the cost would have been $12,708 more.

Upon organization depends the successful maintenance of the track, and one which I find gives the greatest efficiency is that the system is divided up into sections consisting of twelve miles of double track each. Each section is put in charge of a working foreman who is to keep and maintain and repair as cheap as possible, and who is held directly responsible for the condition of the track at all times. He has under him as many laborers as are required to keep his division in repair.

The question as to the right time to reconstruct a track is one of the greatest importance, as it often involves the expenditure of thousands of dollars. The task of solving this question was brought before me not long ago concerning the State street cable track, which had reached a deplorable condition. Taking the track master with me we rode over the line and, as street railroad men often do, guessed that it was time to re-build the track. This involved a very large expenditure, and it would be an expensive guess unless correct, so to ease my conscience and make sure of my guess I had run over the line a car weighing 8,665 pounds, attached behind a grip car by means of a recording spring balance called a dynamometer. This test car was then run over a track newly made at the same speed as over the old line; the dynamometer showed that it took 13.75 pounds more pull per ton to haul cars over the old line than over the new. The average speed of cars on this street is 12 miles per hour. The excess horse-power required to haul one ton was .44, and the excess cost of hauling one ton one hour was $.0088. The num-

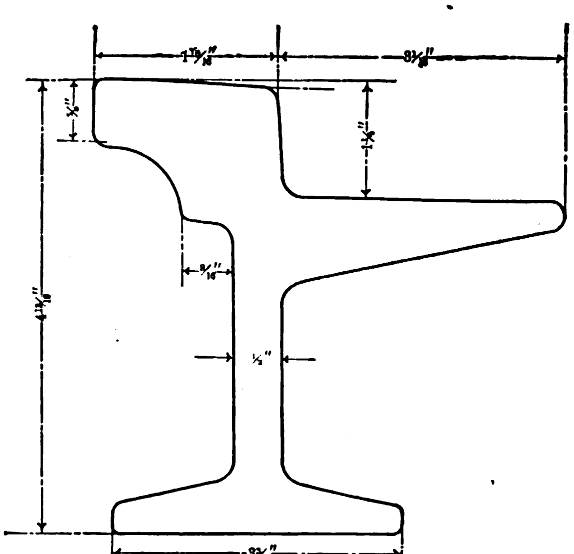


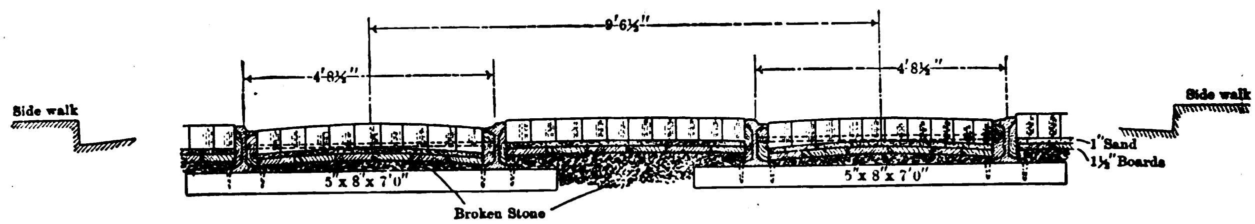
FIG. 3.

ber of tons hauled one mile per year on this track was 4,147,537, and the time required to haul one ton one mile was five minutes; and 45,147,537 tons hauled at a given speed for five minutes is equal in work done to 3,762,295 tons hauled at the same speed for one hour. 3,762,295 multiplied by $.0088 equals $33,108, which is the excess cost per year for hauling cars on account of bad track. It is estimated that the new track with cast joints will last twelve years, and as there will be no low joints, the draw bar pull will not increase much until the rail is worn down sufficiently to allow the wheel to run on the flange, so the annual saving will be nearly $33,108, during the life of the rail, and the total saving will be $397,276, which in twelve years will pay principal and interest on $293,444, which is the amount we could profitably expend

in repairs. The actual cost of re-building this track was $61,670.

This caused me to think up some scheme by means of which dynamometer or power ratings could be taken and automatically traced on paper, showing the condition of the track at all points, showing faults of gauge, level, or joints; showing faults and excess power in consequence of faults, side by side, thus placing a value on faults, and then instead of representing faults and excess power in inches or foot pounds, make the instrument show them in dollars and cents per ton of load when capitalized, which would show, multiplied by the ton miles on any road tested the amount that could, with good management, be expended on track reconstruction, or re-building. The apparatus devised for this purpose is what we call an indicator car. A description of the construction and method of working might be of interest to not a few, for I do not know of another in use by a street railway company, and found only one other, although very dissimilar, in existence on a steam road, after I had the plans of mine finished.

The results shown by it are high and low rails, low joints, gauge, drawbar pull and the variation of the track level. Each one of these results is automatically platted on paper 18 inches wide. The car consists of a platform 8 feet by 10 feet, mounted on a single truck, no springs being used. Midway between the two end axles is one which is fitted with wheels which record defects of joints or gauge. After use and calibration of instrument it will be more valuable and the dynamometer will not be required, as any man using this car constantly will become so accustomed to the value of defects that a glance at the profile will tell him the money he may, with judgment, spend for rebuilding a track or repairing it.



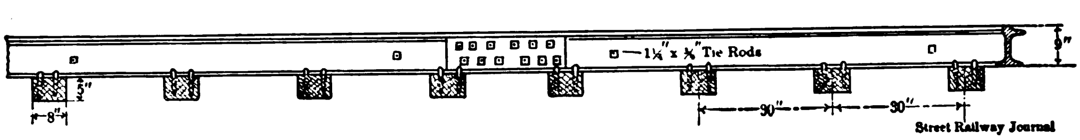


FIG. 4.

The dynamometer consists of two draw bars, one at each end of the car, and extending beneath the platform to within a distance of about one foot of each other. Between the two adjacent ends of the draw bars a spring is placed, and the amount of pull required to draw the car along the track in either direction is recorded by a recording arm, which is connected to the spring with a wire. The apparatus for showing the variation in the level of the tracks is mounted on the platform and consists of two cups of mercury (having a connection between them by means of a pipe) and into which dip two plungers connected to a recording arm. The paper on which the record is taken unwinds at a uniform speed of 1 ft. per 1,000 feet of track. The car weighs 3,865 pounds. The car is fastened to an ordinary car, which is drawn over the tracks by horses (or any motor car) made to go at as even a speed as possible. The results shown by a recent test trip are very interesting to compare. (Various diagrams were added, showing the manner in which the dynamometer car records inequalities of the track.)

We find from the data obtained by use of this car that we could afford to expend $7,383 per mile to repair the old track. The estimated cost of repairing this track, leveling and casting new joints, is $1,740 per mile. The track maintenance during the year 1895 for 184 miles of track cost $158,217 and represented 17.75 per cent. of the total operating expenses. This excessive cost is largely due to a partial or complete rebuilding of many miles of track.

In conclusion I wish to acknowledge receipt of facts and data bearing upon the subject of this paper from Mr. Moxham, Mr. Augustine W. Wright and Mr. Mead; also to thank Mr. W. G. Price for valuable aid rendered me in designing and perfecting the details of indicator car. (The car was open to be inspected in the exhibition room during the convention.)

HOW CAN THE REVENUE OF STREET RAILWAYS BE INCREASED? [1]—I.

BY C. DENSMORE WYMAN, COMMITTEE.

The text that is handed to every general manager, superintendent and directing official of a street railroad company when selected for his position, reads "Increase your receipts; decrease your expenses," and I suspect that there are few if any untried paths leading towards the consummation to which such a text points.

Almost every company, by virtue of its location, the character of the people it serves, the specific requirements of its charter, and the general conditions surrounding its operation, is obliged in adopting any special method for increasing its revenues, or in introducing changes in the conduct of its business to take into consideration these local conditions, and these are as various as are localities of operation.

Our regular line of customers we have always with us, and while their pleasure and comfort is to be cared for, what may be termed the transients, the occasional purchasers of our wares, are to be sought after, catered to, gathered in to increase the regular revenue. In the line of merchandizing, we have rides for sale, and all companies, I doubt not, feel at times that they are overstocked; for the disposal of this stock to attract to our counters not only those who must needs purchase, but as well the wandering, uncertain shopper is desirable.

Imitating the wise merchant, we must seek to place our wares before possible customers in the best condition. We should see to it that what we offer is not shopworn, but is made to appear alluring and enticing. Every car should be a fine looking show window, inviting not only to the regular business traveler, but to the tourist and sightseer as well, who does not know whether to buy a ride or not, and who needs an invitation. Our salesmen are to be as dapper and obsequious as the well drilled and groomed counter-jumper of the merchant's emporium, and all the surroundings of our business should be based upon the principle that to please is the way to get custom and retain it.

Judicious advertising is, I believe, usually regarded as the coin medium of a merchant's business. What ought a railroad company do in this direction? Some of us have doubtless felt that the presence of the cars in the streets was sufficient advertisement of the company's readiness to do business, but it seems to me in this matter we may continue our imitation of the merchant in the conduct of his business. I venture to point out two or three methods of advertising which I think may be successfully employed. First of all, what may be termed "Personal" advertisements through officials and employés.

Every person connected with the road should have it thoroughly impressed upon him when he takes a position that his first and primal business is to "talk up" his company at all times, under all circumstances and to every one with whom he comes in contact. It too often happens that a passenger riding upon a car expresses some criticism to the conductor, motorman or to an official, and instead of receiving an assurance that he must be mistaken, that it is quite impossible that an error such as that of which he complains could happen, or at best that it is surely not the fault of the company, his complaint is readily admitted as just, nay, he is almost con-

[1] Read before the American Street Railway Assoc. St. Louis, Oct. 19-23, 1896. Abstract.

gratulated upon his cleverness in finding weak spots in the company's armor.

Often, even in the office and among the heads of departments, criticism is met in a cringing and apologetic form that serves to make it more positive in the critic's mind that his fault-finding is well founded. However ready we may be to confess to ourselves that all is not just what we may desire, that our company is lame in some respects and halting in others, it is certainly the poorest of policy to make such an admission a matter of public notoriety.

Within the circle of our own counsels, the severest criticism of failure to reach the standard we have set for the men or apparatus may be indulged in, but to the public no intimation of our self-condemnation should ever be permitted to go. Of course, there are times when it may be proper and necessary for the manager to admit that an employé has made a mistake, or that some portion of the system is defective in operation, but the general trend of sentiment to be exhibited to the public on the part of the entire force, from the manager down, should be one of pride in the company, and a habit of talking up, praising, glorying in the institution with which they are connected, should be made a matter of cultivation on the part of the heads of departments, and insisted upon by them from all in the service.

Advertising by the use of printed matter may also be employed with advantage to place before the public. The street railway company's inducements, and publications of this sort are of especial service to strangers and tourists visiting the city in which the company is located. I have found a little folder, upon one side of which is a little map showing the various routes and points of interest in and about the city is printed, with other pages descriptive of the pleasure grounds, parks, cemeteries and other places of resort, together with the time tables of the different lines of our own system, to be of great advantage. These folders, placed at the different hotels, railroad depots and steamer docks, were eagerly sought for by visitors, and distributed upon the cars by the conductors, were very largely used by the patrons of the lines for reference. Our own company issued as an experiment about 50,000 of such folders at the beginning of the past summer season, and the call was so great for them that another issue was found to be justified in a very short time.

If a company's lines have some central point of intersection, from which different routes radiate, signs, giving directions and places to which cars leaving these principal points go, may be of value and serve oftentimes to gather into the company's treasury nickels that, without the information so conveyed, would remain in the pocket of the undecided sightseer. These signs are not expensive and painted upon glass and illuminated they present a handsome appearance. They can be readily attached to trolley poles and lighted from the trolley current. They suggest progressiveness, and an up-to-date policy on the part of the company.

In the endeavor to increase business many street railroads have of late become purveyors of public amusement and as proprietors of parks and outing resorts located upon their lines have gone into the show business with more or less success. In studying this new departure on the part of street railway managers, we recall the Latin adage "Ne sutor ultra crepidam," and quote it as applicable to the inclination of railroad companies to embark in amusement enterprises in connection with the duties directly growing out of the operation of their respective roads.

From such statistics as we can gather, the net revenue gained by companies who have gone extensively into the show business has been in many instances inconsiderable, in some cases a loss has resulted, and but few report substantial profit. Whether to invest in matters of this sort is, however, so much a matter conditioned by the local surroundings, the improvement of unfrequented lines and the ever changing taste of the public, that no general rules for universal guidance can be formulated. We are inclined to say to the general proposition, "Don't go into the amusement business if you can help it; subsidize those who have made that line of life their study, and give over to them the profit of the enterprise other than that gained by the transportation of visitors to their spectacle or resort; "stick to your last, shoemaker, for you have quite enough to do to attend to your own business."

The specially illuminated trolley car for evening excursions is a species of advertising which pays in every way. It can be made a vehicle of pleasure not only to those who pay for its use, but as well to those who delightedly watch its artistic light effects from along the line over which it passes. We believe it tends to popularize the service.

In the smaller cities, the use of the newspaper columns for items of proposed change in car house, equipment, trackage, etc., extensions and improvements ought not to be disregarded. After the wise method of an advance manager for a show, frequently the newspapers should be given news of the proposed improvement about to be entered upon by the railroad company, some new addition to its service, something that will make for comfort or convenience of passengers, or of the proposed opening of some territory hitherto unoccupied. All this tends to the maintenance of interest in the company and the stimulation of a local pride in its doings. Daily newspapers mould public opinion and are especially influential in the smaller towns; they should, therefore, be made vehicles as often as possible of announcements concerning the growth of the railroad and they should be used to make plain the company's anxiety to please the citizens, and to promote the reputation and the growth of the city in which it is located.

We now pass to the consideration of other methods for the increasing of our revenue with the final advice; advertise the goods of the company as the best and cheapest to be had anywhere, on all occasions and always.

In the line of making more attractive the service of a street railway company and therefore tending to increase its patronage, the establishment of a liberal transfer system is worthy of consideration. I am aware that the subject of transfers is one regarding which street railroad men differ widely, and for and against which arguments of the strongest kind are at hand. The difficulties inherent in the wide distribution of transfers, especially upon a large system of railroad lines, are many, among which the liability of the conductor to make of the transfers an opportunity for peculation and a cover for fraud is most prominent. While in many cities a transfer system has been made a subject of municipal enactment especially in the case of recent charters, and thus would seem to have come to stay, in some form or to some extent at least, it is for us to determine if possible whether or not the transfer system is a profitable measure for a street railroad company, and thus where it does not involve other considerations whether or not it ought to be readily adopted.

Inquiries made of various railways touching this point led me to the belief that this question is to be answered in the affirmative. This is especially true of roads making quick time by means of cable or electric power. When a passenger to go a few miles required two or three hours, the transfer system was not specially beneficial or attractive to him, if a business man, who could not spend the time to avail himself of the privilege it gave of long distance riding. But now that six miles an hour rate has been increased to twelve, even in the crowded portions of many cities, and to a much higher rate upon suburban lines, longer distances can be traveled by passengers, visits are made possible within a reasonable length of time to widely separated portions of a city and the only impediment to greater through business between such points is often the necessity of paying two or three fares for such a visit or journey. This impediment once removed, an increase of travel is invited, and a ride upon two or more lines of cars is provided within the same period of time that a single ride was formerly given under the system of horse car traction.

It is, of course, a fact that the hazard of accident to a passenger is increased in proportion to the number of lines which he traverses on a single journey, and this with the labor attendant upon the collection and registry of his fare, and his care while on the cars would perhaps be only fairly paid for by a fare upon each line he may use; but the larger number of persons induced to ride by a very free system of transfers upon a system extending to different quarters of the city of its operation, we believe will compensate for such extra hazard and labor even if it is assumed for a single fare.

This is especially true upon holidays and excursion lines. Almost every street railroad which controls a number of lines in a city has located somewhere upon one of them, and perhaps upon several, points for pleasuring, and to gather from all parts of the city the mass of the people and take them to these places of interest is important. The laboring man who desires to take his wife and children of a Sunday to some outing place, if he can reach that point from his distant home by transferring for a single fare each, is likely to take the journey. If, however, he must needs pay two or more fares of five cents each to get to the point of his pleasure, he remains at home or reduces the number of persons included in his party.

Another favorable argument for the transfer system is the fact that it leads to the settlement in the suburbs of many persons who would not venture so far from their places of business were they not assured of being able to reach them by the payment of a single fare, and this getting of people from the congested parts of a city to its environs, thus assuring the railroad company of their continuous patronage, is most desirable from a railroad standpoint. For these and other reasons which might be mentioned, we believe that it may be broadly stated that a liberal transfer system increases both the popularity and revenue of the street railway company by which it is adopted.

It is quite impossible, with the limit prescribed for this pa-

per, to discuss the question, as fully as its importance deserves, whether it will be found generally profitable for an urban street railroad company to sell tickets good for a fare at a reduced rate by purchasing in quantities, or whether the best interests and profits of a company are secured by adhering to a fixed cash fare of five cents at all hours and times. When the almost universal motor for street railroad use was the horse and the mule, it was a generally accepted fact of experience, derived from the results of street railroad operation in this country, that five cents for an average ride was as cheap as a company could charge and do business at a profit, and was at the same time a most reasonable one for the users of the cars. Thus the charters of nearly all street railroads granted during the horse car period provided that the nickel should be the limit of their charge for a fare.

It is true, as some of our would be reformers in municipal councils and legislative halls loudly announce when seeking political preferment and a reputation for being what they are pleased to call "friends of the masses," that with the change of motive power from horse to electricity or to cable, the street railroads can now afford to reduce, by the sale of commutation tickets, their fares from five to four cents, or even three cents, and still have left a fair margin of profit upon their investment? The cost of transportation of a passenger upon any individual road can be made a matter of almost exact figures, and we believe that when the items properly to be included in such a computation are carefully set down the relative cost of transporting a passenger by horse car, as compared with that of electricity or cable, will be found to be such that any reduction in the fare cannot be made without positive loss to those who have put their money at risk in the enterprise. It is true that with the advent of quicker transit the gross receipts of most all companies that have changed from horse to electricity or cable cars have greatly increased. This is undoubtedly due to the fact that a longer distance can be traveled in the same length of time, and the other fact that congested portions of the city have been relieved and the dwellers therein sent to the outskirts, thus creating new centers of population and business, and, further, that with this change of motive power have come more convenient and pleasanter facilities for transit, inviting not only more of the usual business travel, but an increase in transient, pleasure and excursion riding as well. But to an equal extent with the increase in gross receipts has the expense of installation and operation kept pace, and so preserved in net the former figures. The cost of the reconstruction of a system necessitated by the change of cars and stations, tracks and extensive machine shops, tools and new equipment are the first large items of this expense, and to these are to be added the expense necessitated by costly repairs in maintenance. Further must be added the increase in wages of employés, engineers, mechanics, electricians and skilled machinists, whose employment is necessitated by the new régime, either because they receive more money for their labor or work less hours for the same wages.

A fact that must not be overlooked in this connection is that of the growing demand on the part of the public the company serves, for greater luxury and elegance in the matter of appointments of travel. Our cars must be handsomely and more expensively furnished than were those our patrons were satisfied to use a few years ago. Not only must they move faster, but they must be better lighted, better heated and generally better fitted up for the safety and convenience of passengers than were those accepted formerly. The supplying of these demands has been attended by an increasing operating and maintenance expense. Thus while an increase in the patronage of the road has been in most cases evoked by the change of motive power, we believe it can be safely asserted that little decrease in the expense per passenger carried has been made. This conclusion is brought out by the results attained on the operation of electric and cable roads in the majority of the cities of the country in the past few years, as shown by their reports.

A careful study of the published reports will make it apparent even with the depreciation accounts eliminated that the cost per passenger upon electric or cable roads is not less than that on the horse car which they succeeded. As yet as far as urban roads are concerned we cannot discover that on the whole there is any more profit in a well managed electric or cable street railway than there was in a well-managed horse car road; and we venture the assertion that to-day less of profit in the form of dividends derived from receipts of operation, is being distributed to shareholders in the modern electric or cable roads, proportional to the business transacted than was given them by the old-fashioned horse car companies. From the books and statistics of the majority of companies no favorable arguments are to be drawn for the reduction of fare.

It must also be borne in mind in the consideration of this question that while it is an easy thing to reduce the fare of a road, it is by no means as easy to return to the old rate in case such a reduction results in a loss and proves a failure. Unlike the merchant who may raise or lower the price of his wares and for a day may attract a crowd to a bargain counter in the hope that there may be a profitable sale effected to-morrow, the loss occasioned by a reduction in street railroad fares cannot afterwards be regained by a corresponding increase above the rate originally receded from. Higher than the five-cent point we may not go, and if once lowered, even with the plainest statements of the loss it entails before the public, an attempted return to the old rate is provocative of dislikes on the part of the patrons and is almost sure to set in motion legislative action designed to compel the continuance of the lower fare. Such a reduction, therefore, since it is likely to be permanent and continuous, whatever may be its effect on the company, is made at the risk and in the face of the various contingencies, which surround the business of a road which must maintain an uninterrupted service through fat years and lean years, through times of depression and dullness, when competition and an uncertain labor market may make inroads on its income, and therefore is, to say the least, decidedly hazardous.

By the advocates of reduced fares it is ordinarily assumed that the cheaper rate will invite a sufficiently greater number of new riders to make good the difference in income by the lessened price to each. But we believe that a computation based on the earnings of almost all companies at the five-cent rate to ascertain how many more passengers, say, at a four-cent fare, would have to be carried to make good the difference between the two rates together with the increased cost for the more carried, including the risk assumed of accidents, will demonstrate the fallacy of such an argument.

The old adage "quick sales and small profits" will not apply in this matter. A less reduction than one-cent per fare will hardly be acceptable or sufficiently attractive to induce a more liberal patronage of the cars. But the reduction of one cent in five entails the loss of a higher percentage of the original price and which is much greater than the ratio of original profit. The fallacy of such a reduction is well stated in the editorial columns of a recent issue of the "Street Railway Journal." It is there remarked, "A loss of twenty per cent. of their gross receipts following a reduction of fares from five cents to four would send half of our best paying roads into bankruptcy and would so cripple the others as to make improvements in service practically impossible. A further reduction of twenty per cent. would make them all shut down."

For want of time we have not made mention of the serious danger to a company of loss through peculation by the conductors where the cash fares upon the road are fixed at one rate and commutation tickets are sold and received at a less rate. If the value of an article consists in the cost of its production and its exchange, we think in the light of present street railroad operation that the standard five cent fare is a just and reasonable equivalent for an average ride upon a street car, and that no reduction therefrom is advisable or expedient.

FIFTEENTH ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION.

THE fifteenth annual meeting of the American Street Railway Association was held at the Auditorium Building, St. Louis, Mo., October 20-23, 1896. President H. M. Littell, of New York City, presided, and Secretary Pennington, of Chicago, assisted. The meeting was opened with an invocation of divine guidance by Rev. P. G. Robert.

President Littell introduced Mr. Charles Nagel, acting mayor of St. Louis, who delivered an address of welcome.

THE PRESIDENT announced the next business to be the calling of the roll, which was accordingly done, and it was found that seventy-five companies were represented.

The address of the president being next in order, President Littell delivered his inaugural address.[1]

On motion of Mr. Green, of St. Louis, it was voted that the address of the president be printed separately, one thousand copies.

MR. BAUMHOFF, of St. Louis: Mr. Chairman and Gentlemen—This meeting marks a new era in the history of the American Street Railway Association. Fourteen years ago Mr. H. M. Littell, then general superintendent of the Louisville City Railroad Company, and now vice-president and general manager of the Buffalo Street Railway Company, conceived the idea of the benefits which might accrue to the street railway managers by the formation of an association of this character, and after a conference with a number of friends, it was deter-

[1] See page 419.

mined to call a meeting for organizing what has since developed into one of the grandest associations in this country. (Applause.) Accordingly, invitations were extended to representative street railway managers throughout the country to attend the initial meeting in the city of Boston, in the month of December, 1882. Like the spokes extending from the hub of a great wheel, this association has spread throughout our great land. We are in a new era, because we have eliminated the discussions of the care and feed of horses, the construction and ventilation of stables, and other sundry annoyances which at that time tended to make the life of a street railway manager anything but pleasant. It is a new era, because you have met for the second time in our midst, and we proudly point to the fact that we have transformed our last animal traction road to one operated electrically. Mr. President, in behalf of the Chicago City Railway Company, I present to you this handsome gavel, made of the hardest and most durable wood, inclosed in this handsome box made from the sill of a car which has for many years done service on the Chicago City Railway. May this convention, as it is called to order by the rappings of this gavel, pass into the annals of history as one of the most pleasant and beneficial gatherings of this character. (Applause.)

PRESIDENT LITTELL: This, gentlemen, is indeed a very agreeable surprise, and I am in hopes that it will be sufficiently large to preserve order. I thought when I was elected president of this association that my position would be such that I would look down upon all of you, but I find upon entering this hall, that you all look down upon me; the fact is, I think you have got me in a hole. (Applause.) I am pleased with the prospect that with the assistance of my friends it will be possible for me to preserve order with this beautiful gavel.

MR. BEAN: Mr. President, as Mr. Baumhoff has pleasantly reminded us of the Boston meeting in 1882, I would ask that every gentleman present who was at that meeting, will rise for a moment. Messrs. Green, of St. Louis; Smith, of Troy; H. H. Littell, of Buffalo; Rugg, of Pittsburg, and Bean, of St. Joseph, Mich., rose.

The secretary then read the minutes of the meetings of the Executive Committee held during the year, and closed with the report on membership, showing that the membership in October, 1895, was 173 companies; eight new companies had joined the association; three had become consolidated; one company had withdrawn, and thirteen companies had been dropped for non-payment of dues, leaving the present membership 164 companies.

The committee referred to the fact that at the beginning of the present fiscal year the association was in debt $6,000, and that this indebtedness had been cancelled, and the income during the forthcoming year would be about $6,500, which would enable the secretary to enlarge the scope of the work of the association, it being contemplated that a monthly bulletin shall be issued, containing information of value to the members.

THE PRESIDENT: The first paper on our list is that by Mr. M. K. Bowen, superintendent Chicago City Railway Company, on "Track and Track Joints, Construction, Maintenance and Bonding."[1]

MR. ROBERT McCULLOCH: With regard to the carrying of the current over a welded track without bonds, we have one piece of track which is thirteen miles long and all welded together, the most of it being 60-foot rail. We have not an ounce of copper nor a bond of any kind on the entire track. We have made tests of all sorts, with delicate instruments, graded to the thousandth part of a volt, tested as long and as short lengths as possible, sometimes a mile and sometimes a single joint, and have found in most instances that the carrying capacity of the joint was greater than that of the rail at any other place. We have found no necessity for bonding, our contact is perfect at the extreme ends of the rail, and I do not believe it is necessary to bond a welded track. All the tests we have made have been on track that was laid about ten months since. The tests were made about two months ago, so that the oldest joints we tested were about six or eight months old. It is cast welding.

MR. SEELY: I wish to know whether it is necessary to own a plant for repairing purposes in case the joints are broken? How do you repair joints after the welding plant is taken down? I know that to weld a mile, or four or five miles, it is not expensive to run a cupola; but it would be in the case of repairing a few joints now and then.

MR. BOWEN: For a small road it would be better to let the contractors repair the broken joints. For a large system it would probably be better to keep a cupola; you are always building more or less track and doing a considerable amount of repair work. A large system is generally building new track, and you could use a machine and make it pay for itself.

MR. DODGE: You spoke of something like 200 joints out of 1,700, which parted. How soon after the casting of these joints did they part; was it very soon after they were welded?

MR. BOWEN: We lost the joints on account of contraction, due to very cold weather, in midwinter. With the first cold snap, the contraction of the rails pulled 154 joints apart. The joints were then repaired, and since then they have gone through the summer the same as the other joints. The joints were cast in midsummer, during the night hours.

MR. SOULLIN: Were most of the joints examined, or simply those found broken? I want to ascertain if the joints were not loosened as well as broken—some of them loosened in some way or other, and which was not perceptible until they were closely examined.

MR. BOWEN: There were 154 remade. When they do part it is for 2 or 3 inches, so that you can see them readily. If there is any oxidation between the joint and the rail, I hardly imagine it would do any harm unless it was sufficient to loosen the cast iron from the rail proper. In that case it would come apart 3 inches, due to the contraction of four or five blocks of steel. In repairing a rail with a space of 3 inches, we saw a piece of rail and cut it in, and recast around the entire two joints in that case. The average cost of the joint is about what the contractor can get out of it—I do not know whether it is a trade secret or not. The joint requires 100 pounds of cast iron, so that you can make your own calculations.

MR. WYMAN: Mr. Bowen says that he uses the bond in order to be absolutely certain of obtaining conductivity in the rail. Will he kindly tell me how he uses it, around the weld or beneath the weld?

MR. BOWEN: We simply bond the track after we cast the joints; a long bond around the weld.

MR. WYMAN: You said just now that when one of those welded joints pulled apart, as they do naturally, they would pull apart 2 or 3 inches. Do you allow for that in your bond?

MR. BOWEN. When the joint pulls apart, in all probability it ruptures the bond. If it does, we put in a new bond. I am not sure that the practice will obtain after the next year or two to come.

MR. GOFF: May I ask what trouble you have in the summer time? I have in mind a track which I think was bonded in the winter—cast in the winter—and in the summer time it seems to be out of line all the time. The car has a waving motion over the track. Do you have any trouble of that nature?

MR. BOWEN: That comes from the casting. Mr. Littlefield, of the Johnson Company, told me that the rails usually delivered to consumers are not sawed square on the ends, but are sawed with the ball on the bias; in other words, that the ball of the rail comes together, and the flange of the rail does not. I have noticed that in laying rails. You will find as you put your mould on to cast the joint that the rails have contact at the ball and not at the flange at all. If you are not careful the rail will do two things—it will go out and it will go up, on account of the majority of the iron being underneath the rail. The contraction in cooling will push it up and push it out. In order to prevent that we put a clamp on the rail when casting it, and push it in a quarter of an inch, and down a quarter of an inch.

MR. GOFF: Did you have this trouble before you cast the track in the manner you just mentioned?

MR. BOWEN: We cast straight joints now; we used to cast crooked ones.

MR. GOFF: What temperature do you find gives the best results? Do you take the season of the year when the temperature is cool, or can you do it equally well in the summer or late in the fall?

MR. BOWEN: I should advise the majority of joints to be cast at night, so that the temperature will be cooler. I advise a medium temperature, a little cooler than the medium temperature for your climate, whatever it is. We like to cast at a temperature of between 40 and 50—somewhere about 50 degrees.

MR. A. JOHNSTON: In the examination of the broken joints by contraction, did you find that the rail pulled out of the cast iron?

MR. BOWEN: Occasionally, but more often on account of our driving two pins through the last two holes of the fish plate. We have supplemented the joint with them. We find then that it tears the casting apart.

MR. JOHNSTON: Then the cast metal is in the mass, but still it is not a homogeneous mass?

MR. BOWEN: It is not in spots. There is a spot on each side, which shows amalgamation.

MR. JOHNSTON: That is something important, because if there are no spots where it is amalgamated to the steel rail you would not have a good electrical connection.

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[1] See page 422.

MR. BOWEN: I have cut off many joints, and I have found some places where the amalgamation has taken place, and some where it had not.

MR. JOHNSTON: Have you allowed a time test as to the amalgamated metal carrying the return current through the joints?

MR. BOWEN: In welding your rails you would have to be careful to clean the rails, or you would not get a good electrical connection. The 63-pound rail was the lightest we have used, 4½ inches high, which we used on chairs. That is the lightest rail. The heaviest rail is a 7-inch, 83-pound rail. We have used no chairs on the 9-inch construction. In the 9-inch construction we use in our electrical work malleable iron chairs; but this happened to be a steel chair that was used. The bond we use is the Columbia, made by the Roebling Company.

MR. DODGE: I will say that in New Haven, Conn., there are about 1,500 joints there which have been cast on 50 and 60-pound T-rail. Some one has inquired about the cost of these joints. I understand that the man who is putting them in at New Haven on the 50 and 60-pound T-rail is getting $3.25 a joint; the railroad company having to pay the freight to and fro on the apparatus necessary.

MR. H. H. LITTELL: I ask Mr. Bowen, or any gentleman present, if they have had any trouble or experience with the pulling apart of the rail, pulling the rail in two, not at the joint, whether welded joint or put together with splice bars, pulling the rail in two by the contraction?

MR. BOWEN: I think that there were one or two cases on our road of pulling apart. Instead of the fracture being just at the joint, it was some little distance back, probably where the difference between the extreme heat and the ordinary temperature of the rail left a partial fracture; there were only one or two cases.

MR. LITTELL: We have no welded joints in Buffalo. We have the ordinary track laid with 9-inch rail, 94 pounds to the yard. Summer before last we put down some 9-inch rail in hot weather, forcing the rails just as close as we could, leaving them uncovered until the morning. In the morning we drove the rail back, a lot of men with a heavy timber, and drove the rails up as close as we could, and put them together with a twelve-bolt splice bar, 1-inch bolt. We got along very nicely for a time, but winter before last we had one of the rails pull in two, 13 feet from the joint, a 32-foot rail, 9 inches, weighing 94 pounds to the yard.

MR. SEELY: We have had some experience in that line, 90-pound girder rails pulling in two, on an elevation, grade of about 5 per cent. We have this occur every winter; the rails break right in the center. The joints are driven too close together, and the rails are bound to expand in some direction. We also find that with the high carbon rails we are using, it is almost impossible to cut them with the ordinary tools; we require special devices for sawing rails in two. In sawing rails, if you have to turn them over, they will crack all the way down the center, and we are compelled to handle them with the greatest of care.

MR. DODGE: In the cases where you mentioned the rail as being forced up, breaking your joint, did you break that in pieces and make a new joint?

MR. BOWEN: That was not the fault of the casting, and we corrected those cases and have only a few left, pushing them down and recasting. It is faulty work.

MR. DODGE: This concern which is doing this work in New Haven follow this plan, when it is thrown up in that way—and I saw quite a number—they start back 2 or 3 feet and grind it down with an emery iron across that joint.

MR. BOWEN: We do not do that. We file down, but merely for the purpose of getting the proportions of two rails alike, when they are of different heights or something of that sort. We won't allow a joint to be cast and leave it high now. It is necessary with every joint to smooth it off, and we are careful to smooth it off so that it has a perfect surface. You cannot tell it from any other part of the rail. We do this because a joint which once begins to pound is half worn out.

MR. McCORMACK: In answer to Mr. Littell's inquiry about the experience with cast welded joints, our company in Brooklyn put in 2,000 cast welded joints on the 94-pound rail, 9-inch girder, and out of that number there was only one which pulled the rail apart; the rail broke about 4 inches from the end. They have given us very good satisfaction, at least we think so. We had some on our old 6-inch rail that broke, but we thought that was due to the kind of rail.

MR. SCULL: Are you paying the Falk Company a royalty?

MR. BOWEN: Yes; we have thirty-two thousand joints in, and pay so much royalty for each joint.

MR. LITTELL: On the street that this particular rail parted in two we have four curves. At two points on this street the special work pulled apart at the curve, and in one instance the joint of the rail only separated; the rail pulled apart at the joint. On examining this joint we found that the trackmen had slighted it. They had relaid the track, and when they connected up that joint they put in some small bolts, so as to connect it up, and when they put in the new rail they left in some ¾-inch bolts instead of using 1-inch bolts. It could not be drawn up tight.

MR. HEFT: Why use a copper bond with a cast welded joint; is it done as a precautionary measure?

MR. BOWEN: I did not know just what to do. We cut off probably ten or fifteen joints, just taken at random along the track, and out of that number I found several in which we failed to have any amalgamation in these little spots I have described with the rail. I will say that that was in the first part of our work, probably a year ago. Then to prevent tearing up a granite pavement afterward to bond, which we were putting down on that line of road, I thought it was cheaper to bond, and be sure, than not to bond and be sorry. I am waiting now for the development of that matter. I think Mr. McCulloch has made some researches in that direction, and I am down here principally to hear from him on that subject.

MR. HEFT: Then you do not feel safe in the present state of the art without using the copper bond?

MR. BOWEN: That is my position.

MR. DODGE: About that polishing up of the side of the rail, you were particular in getting the surface bright?

MR. BOWEN: Not so bright, as we were using the joint with a bond.

MR. DODGE: The Falk Manufacturing Company, which has been doing the work in New Haven, polished the joints by an electric motor, and the motor gave out, so that they could not use it. I was looking over their work and saw a man polishing the joints with a file. I asked him if it was not necessary to have it brighter, and he said: "That is just as good." They were using it without a bond.

MR. BOWEN: Then they will burn some coal. (Laughter.)

MR. DODGE: It struck me that way.

On motion the meeting adjourned until 9 o'clock Wednesday morning.

WEDNESDAY'S SESSION.

President Littell called the meeting to order and announced the first business to be the reading of the paper on "Trucks," by Mr. John N. Akarman, superintendent of the Worcester Consolidated Street Railway Company, Worcester, Mass., who was unable to be present.

Secretary Pennington read the paper.

Vice-President McCulloch took the chair. The paper on "The Modern Power House" was then read by Mr. Richard McCulloch, civil and electrical engineer, Citizens' Cass Avenue and St. Louis Railways, St. Louis, Mo.

MR. ROSSITER asked if any of the members had had occasion to use the storage battery, and if so, with what success.

MR. RICHARD McCULLOCH: There is one installed somewhere in Pennsylvania, and the Union Traction Company, of Philadelphia, have one installed at the end of one of the long lines for the purpose of regulating the voltage at that point, but there is a storage battery in operation in parallel with the dynamos, I think, at Easton, Pa.

MR. B. J. ARNOLD: During the last year I have had installed in the Chicago Board of Trade plant, as the consulting engineer for that corporation, a battery auxiliary. In my opinion the work of the plant is more severe, if anything, than electric railroad work, because it operates electric elevators in conjunction with constant potential arc and incandescent lights. The elevators take a startling current varying from 0 to 800 amperes, and back again almost instantly, corresponding in abruptness to the load on an electric railway operating three or four cars. In the Board of Trade plant the battery auxiliary acts as an equalizer and takes the surplus load delivered into the bus cars, when the demand on the line is less than the capacity of the generator, and takes three-quarters of the overload when the pull comes. The result is that with a 75 kilowatt generator, running from 7 in the morning until 11 o'clock at night at its absolutely normal economical load, it produces sufficient energy to operate fifty 2,000 candle power arc lamps, 600 incandescent lamps, four 30 horse-power electric elevators, and six 10 horse-power motors, all running from this one unit, and the unit constantly loaded. That is my experience with the battery, and it is working perfectly satisfactorily, having been running nearly a year and has cost practically nothing for repairs. We have increased the plant by putting in additional plates, because we required additional capacity, but there was no charge for repairs, and I am convinced that the battery auxiliary, when there is sufficient lead installed to do the work, is an eminent success for regulating work and economical operation of power stations operating on variable loads. I do not take this

stand without having gone into the matter pretty thoroughly, and I feel sure of my position. You must get lead enough into the battery to do the work, and having that, you will get good results, that you can rely upon and base your calculation for economical operation.

The battery was made by the Electric Storage Battery Company, Philadelphia-Manchester type of positive plate. That is another thing you gentlemen should be careful about in your investigations—the type of plate you get. It makes all the difference in the world if the plate is built for regulation or for slow discharge. This particular type is for regulation and also performs the function of slow discharge if necessary. The engines and generators stand idle from 11 o'clock at night until 7 in the morning, and the battery does the work through the night. That enables the engine to operate sixteen hours a day, with two shifts of labor, at its economical normal load, and shut down at night until morning. That can be effected in a large number of electric railway plants in this country with success. It is only a question whether the increased economy will be more than the interest on the investment of the cost of the battery. I am installing now three different stations, part railroad and part lighting, in which it is my idea to use batteries, by which I will find it necessary to put in one-third less capacity of engines and generators that would be otherwise necessary.

MR. HAWKIN: What is the life of the plate under constant use?

MR. ARNOLD: I cannot tell you; the plant has not been running very long, only about one year. It is guaranteed at 7½ per cent. per annum. On that basis I figure out a marked economy and feel that we are safe because the company behind the battery will stand up to the guarantee. As a matter of fact it has not cost 1 per cent. this year; probably it will cost something next year, and so on each year, but the battery company stands behind it.

MR. HARRINGTON: What is the construction of the two plates, the positive and the negative?

MR. ARNOLD: The negative plate is what is known as the chloride negative. It is cast lead containing square pellets of spongy lead originally peroxide of lead and reduced to spongy lead. The positive plate is a lead grid containing antimony, so as to make it hard and has round pellets, which consist of strips of corrugated lead, coiled on themselves, like a spiral, the lead being cast around it, or the spirals pulled into plate, and afterwards converted into peroxide of lead by an electrolytic process, and the plate when thus completed is called the Manchester plate. It is porous and you get a quick discharge on a heavy pull, and it does not buckle and fall out, as some battery plates have done in the past. One thing I will speak of which may interest you—that is the method of charging the battery. By running the electric elevators and the battery auxiliary in parallel with the shunt winding of the generator, and by running the lights in the building on a separate set of bus bars off the compound winding of the same generator, so that the variable load on the elevators is taken care of entirely by the shunt winding and the battery, while the compound winding works constantly on the lighting load, I get the best regulation, so that the fluctuation of the voltage is not noticeable in the building. There is a slight variation of from two to eight volts under extreme conditions, which seldom occur, but is good enough in practice, so that one unit does the work without serious fluctuation in voltage.

We use a booster in the station, which consists of a motor generator to charge the batteries, if it ever becomes necessary, while the generators are running on the lines, because then voltage must remain constant at 125 volts. Then if we wish to charge the batteries we use the auxiliary booster to charge the end or regulating cells, while the shunt winding of the generator is working in parallel with elevators and about sixty of the cells. The elevator service is such as to allow the battery to be charged and discharged in about equal proportions through the day, so that it is practically fully charged at the end of the day's run, and at night if they are slightly discharged we charge them up with the booster by placing the generator end of it in series with the main generator, and at 11 o'clock shut down the engines and run the lights until morning with the batteries. In a railroad power station it would be necessary to use the booster to increase your voltage on your long feeders. If the battery were located at the end of the line you would have to use the booster to overcome the pressure at the battery, or else run a separate high voltage generator.

MR. HARRINGTON: I understand from the experience of a large number of railway engineers that the ordinary size plant, running from 200 to 250 horse-power, where the load constantly changes, that by reason of trouble on the line the standard forms of multipolar generators flash from brush to brush, and cause a great deal of trouble in the commutators of the machine. That is a common occurrence in the Philadelphia Traction Company's plant; they suffer from that trouble there. We have had it in our own plant, with both Westinghouse and General Electric machines. The storage battery would be an excellent thing to avoid that form of breakdown or delay, due to the burning of the commutator. I would like to know if any one here has had the same experience in the stations operated by the gentlemen here.

A communication from the Engineers' Club of St. Louis was read, inviting the members to attend a meeting of that club, to be held in the evening.

The privileges of the floor were granted to Mr. Seiryo Mine, Electrical Engineer to the Japanese Government, who was present.

THE PRESIDENT: We will now proceed to the consideration of the paper, "How Can the Revenue of Street Railways Be Increased, taking into consideration the collection of fares, method of registry, transfers, use of tickets or cash fares, and attractions along the line of the road?" by Mr. C. D. Wyman, general manager of the Milwaukee Street Railway Company, Milwaukee, Wis.

Mr. Wyman read the paper.[1]

MR. SEELY: I ask the author of the paper whether he found any opposition to the issuing of this pamphlet by the trade unions of the city. You were going into the advertising business, when you solicited advertisements, and I believe there has been some objection to that by threatening a boycott.

MR. WYMAN: As far as advertising went we only had a very few advertisements, and they were from very strong firms, that I do not presume any trades' union would have any effect upon. We had, perhaps, half a dozen. The cost of the paper was very little—for the 1,500 or 1,800 copies which were issued monthly, about $15 or $20, so that it amounted to little or nothing. We had at that time a union, which has now passed away, and there was some talk about its being intended to disrupt the union. In one issue of the paper I suggested the formation of a benevolent society, and that caused a great disturbance among the men, but that did not make any difference to us. We went right on just the same, and after a while, inasmuch as the paper only covered the ground intimated, simply giving information concerning the operations of the road, and perhaps mentioning some employé of the road that did something worthy of notice, all that trouble died out. At first the union looked at it somewhat askance, and I believe advised its members not to read it, but that soon passed off, and every issue of the paper was freely taken by the men.

THE PRESIDENT here announced that cars would leave the Southern Hotel promptly at 2 o'clock for the Fair Grounds, and all in attendance at the meeting were invited to accompany the party.

THE PRESIDENT then appointed a committee to nominate officers for the ensuing year and to report upon a place for the next meeting.

The meeting then adjourned until 10 a. m. Thursday.

THURSDAY'S SESSION.

PRESIDENT LITTELL called the meeting to order at 10:40 a. m. The secretary announced that the following companies had joined the association: Street Railway Company of the Federal District of the City of Mexico; Atchison Railway, Light and Power Company, Atchison, Kan.

MR. H. H. LITTELL: I feel safe in saying that the exhibit made by the manufacturers and dealers in railway supplies at this meeting is the largest, finest and most complete that has ever been shown at any meeting of this association. I do not know of any better way to show our appreciation and to encourage the efforts put forth by our friends in the trade than to take a recess for the purpose of examining in a body their goods and wares. I move that before proceeding with any other business we take a recess until 12 o'clock to inspect the display of street railway supplies. Carried.

The meeting accordingly adjourned.

The delegates reassembled at 12 o'clock.

THE PRESIDENT announced that at 2 o'clock cars would be in waiting at the Southern Hotel to take the attendants to the Anheuser-Busch Brewery, and that the annual banquet would take place at half-past eight o'clock in the evening.

THE PRESIDENT: The first order of business is the reading of the paper on "Modern Overhead Electric Construction," by B. Willard, general superintendent New Orleans City and Lake Railroad Company, New Orleans, La.

Mr. Blake read the paper, Mr. Willard being unable to attend the meeting.

The Nominating Committee then reported the following nominations:

For president, Robert McCulloch, vice-president and general manager, Cass Avenue and Fair Grounds Railway, St. Louis, Mo.; first vice-president, Charles S. Sargeant, general

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[1] See page 424.

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CONTENTS.

THE BERLINER PATENT.

THE argument before the United States Supreme Court in the suit of the United States vs. the American Bell Telephone Company, has been reassigned by the Supreme Court to November 9 at the head of the call. Our readers will remember that this suit was brought by the United States to cancel the Berliner patent, No. 463,569, owned by the Bell Company. The suit was begun in February, 1893, by the Attorney General on behalf of the United States, and reached a bearing in June, 1894, before Judge Carpenter, of the United States Circuit Court, District of Massachusetts.

Judge Carpenter adjudged in favor of the United States, and ordered the cancellation of the patent on the grounds of fraudulent delay in the Patent Office, and a previous patent to Berliner which disclosed and claimed in combination the identical apparatus claimed in the patent under suit. The Bell Company appealed from his decision to the Circuit Court of Appeals and obtained a judgment overruling Judge Carpenter's decision. The United States then appealed to the Supreme Court.

It is understood that Mr. Joseph H. Choate, of New York, and F. P. Fish, of Boston, will appear for the Bell Company, and Judge R. S. Taylor, of Fort Wayne, and Causten Browne, of Boston, will present the case for the United States, both by oral arguments and briefs. The Attorney General has also appointed as special assistant counsel for the United States ex-Solicitor General Charles H. Aldrich. It is understood that Mr. Aldrich will argue in greater detail some of the points set up by the United States for urging the cancellation of the patent. In view of the near approach to final conclusion of this celebrated case it may not be without interest to recall briefly its history.

The Berliner patent in question was applied for on June 4, 1877, by Emile Berliner, and after a delay of more than fourteen years in the Patent Office, was issued to the American Bell Telephone Company on November 17, 1891. The bearing of the patent upon the telephone business is briefly as follows: On March 7, 1876, over a year previous to Berliner's application, the government granted to Alexander Graham Bell the fundamental patent on telephony. Not only did Bell claim "the method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth," i. e., by his magneto telephone, now and for years universally used for the receiver, but he also claimed "the method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit . . . as set forth." This claim has been held to cover the method of all microphones. Under it the Bell Company would justly control the telephone business during the life of the patent. Just previous, however, to the expiration of this patent, the Patent Office issued to the Bell Company the Berliner patent, which had lain in the office for over fourteen years, and by which they now hope to extend their monopoly over an additional period of seventeen years, or until 1908, a total period of more than thirty-two years. The Berliner patent claims:

"The method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described."

The second claim is equally broad and covers the transmitter as an apparatus for thus transmitting speech. In other words, the Berliner patent apparently covers the apparatus necessary in order to utilize the invention of Bell, although such apparatus had been continuously and successfully in commercial use for thirteen or fourteen years, during which this patent lay in the Patent Office awaiting its issuance.

The American Bell Telephone Company has argued that the patent was secured under the rules of the Patent Office, and that "it was absolutely impossible for the defendants to have hastened the grant of the patent." On the other hand, the United States claims that the delay was unnecessary and amounted to bad faith on the part of the Bell Company toward the public. Among other grounds set up by the United States urging the cancellation of the patent are (1) Irregular procedure in the Patent Office outside of the uncalled-for delay, and the insertion of new material subsequent to the filing of the application. 2. The application as filed did not describe the constant-contact, variable-resistance transmitter which is the subject matter of the patent as issued, but did describe a "make and break" transmitter for the transmission of speech. The original application and drawings were twice erased and stricken out and new ones substituted containing the constant-contact device. 3. The United States claims that the invention in question was described and disclosed and claimed in combination with the identical apparatus used as a receiver in the patent of November 2, 1880, granted to Emile Berliner.

The decision of the Supreme Court will, of course, be of great importance to the public, for it is believed that the Bell Company own no other patents of sufficient scope to extend their exclusive monopoly beyond the twenty years which they have already enjoyed. Should, however, the Supreme Court uphold the validity of the patent it would appear that the public must still be deprived of most of the advantages of active competition until the year 1908.

THE ST. LOUIS STREET RAILWAY CONVENTION.

THE return to St. Louis of the American Street Railway Association, for its annual convention, after several years of absence, has been a very interesting event. It is by such a return that one is able to measure the distance that an industry has traveled. When the association met last in the great city by the Mississippi, the horse was still the motive power of American street railways, with the prospect of a long supremacy, for the cable was seen to be suited only to large cities and electricity had a few visionary advocates like ourselves, who could hardly obtain a hearing even in their own field of endeavor. To-day St. Louis is a splendid type of what can be done in supplying a great population with satisfactory travel by means of the electric motor, and electric traction is triumphant in every city of the Union—New York alone excepted. In fact, all future work is largely predicated upon electricity, except in New York again, where some people are foolish enough to dabble again in experiments with that which has ever been found a failure, for such work, namely, compressed air.

The St. Louis convention this year has been highly successful. The meeting was very well attended, the exhibit of apparatus was far beyond the average, and the papers and discussions were of an admirably useful character. It is true that a tendency to go into executive session is beginning to manifest itself, a development often associated with moribund conditions in such bodies; but the matter is one that must be settled for itself by an organization and that which speaks for street railways is certainly more vigorous and prosperous than it has been for some time past. Its wise choice for president, Mr. McCulloch, is an earnest of willingness and ability to do good work in the future, and to the support of such an administration all well wishers of the industry will rally.

While the papers and reports read before the convention were not numerous, what they lacked in quantity they made up in quality. Without exception, they treated specific subjects of the highest importance in the railway management in an intelligent and instructive manner, and furnished a good basis for the discussions which ensued. Some of the reports being left entirely to individuals, they may, of course, reflect to a large extent the individual opinions of their writers, but in general their contents are of distinct general application. As to the best methods of increasing the revenue of a road, which formed the subject of one of these reports, besides the more general observations which would suggest themselves to most intelligent managers, we note particularly the results of the attempts made to increase receipts by the inauguration of pleasure resorts on the line of railroads. Such resorts, it would seem, have not been uniformly successful, and, indeed, but few have come up to the expectations of the companies which added them as passenger feeders to their roads. But while experience would indicate that railroad companies are not successful show managers, or caterers to public amusement, there is no reason, as pointed out, why these adjuncts should not be encouraged, but their management left in the hands of independent parties who have made the business their own particular study. We believe that this suggestion will be followed in the future, thus leaving the railroad company to the exploiting of its own legitimate business, the carrying of passengers. The question of transfers was also very properly dwelt upon in the report. We believe that experience has fully demonstrated the wisdom of a liberal transfer system, and we know of no better way by which a steady, paying passenger traffic from and to suburbs can be built up. After all, it is the men of moderate and small incomes to whom the street railway companies must look for a large percentage of their income, and anything that can encourage this class of passengers to avail themselves of the facilities offered must lead to an increase in the receipts.

The question of the advisability of reducing the standard rate of fare now existing elicited the information that there is no more profit in urban electric railways than there was in the old days of the horse. There is, in fact, less in proportion to the business handled. This might look like an arraignment of the electric railway, but to those who know the greatly increased and exacting demands of the public in the way of conveniences since the electric car entered the field, the information will not be a particularly startling piece of news. For the present, therefore, we believe that no reduction in fares is possible if roads are to be run and maintained at their highest efficiency, but there may be hope for the future when the experience which time brings with it will have shown the mistakes of the past, and these have all been paid for out of earnings, as they must always be.

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manager, West End Street Railway Company, Boston, Mass.; second vice-president, D. B. Dyer, president, Augusta Railway Company, Augusta, Ga.; third vice-president, C. F. Holmes, general manager, Metropolitan Street Railway Company, Kansas City, Mo.; Executive Committee, H. M. Littell, vice-president and general manager, Metropolitan Street Railway Company, New York City; H. P. Bradford, general manager, Cincinnati Inclined Plane Railway Company, Cincinnati, O.; Chas. H. Smith, superintendent, Troy City Railway Company, Troy, N. Y.; Harry Scullin, vice-president and general manager, Union Depot Railway Company, St. Louis, Mo.; George B. Hippee, general manager, Des Moines City Railway Company, Des Moines, Ia.; for secretary and treasurer, Thomas C. Penington, treasurer, Chicago City Railway Company, Chicago, Ill.

The report was accepted and the secretary instructed to cast the ballot of the association for the gentlemen nominated.

Calls for Mr. McCulloch.

MR. ROBERT McCULLOCH: I will only say that if I had constituted the entire nominating committee, or been the returning board, or if I had carried the electoral vote in my pocket, you would have had a different standard-bearer for the ensuing year, and for fear you may think I am not appreciative, I will not criticise your action. I thank you for the personal compliment you have paid me, and the courtesy you have extended to the city of St. Louis; and all I promise you is that while I sit on the executive throne of the association, your banner shall not be trailed in the mire. (Applause.)

The Nominating Committee also designated for the next place of meeting, Niagara Falls. (Applause.)

MR. LANG stated that some of the material men had said that they thought there might be a lack of facilities for getting their heavy machinery and cars in and out. He was assured that it will be most convenient to get cars and the machinery in and out owing to connections to be made not only with the street railways, but also with the steam roads.

MR. SEELY offered the following resolution:

"Whereas, Suggestions and propositions have been made looking to the consolidation in one body of the American Street Railway Association and the National Electrical Light Association,

"Resolved, That in the opinion of the American Street Railway Association such union is not called for." (Applause.)

The resolution was adopted.

The secretary read the following letter:

To the American Street Railway Association:

Gentlemen—I would respectfully ask that a committee of five be appointed to consider the propriety of this association adopting a standard code of rules and regulations for the government of employés, something similar to the practice of steam roads.

I fully appreciate the objections which this will meet with, but believe it is in the line of advancement, and any road can adopt the rules in their entirety or in part. Local conditions would make it necessary for changes in a large number of the rules that would probably be adopted, but in the main the instructions to conductors and motormen about reporting, conduct, etc., would apply to all. It would be valuable to have this class of employés educated, so that their principal duties would be the same on all roads. Owing to the opening of a new line it is necessary for me to leave here at noon to-day, which is my reason for addressing this to the convention in writing.

IRA A. McCORMACK,
Gen'l Supt. Brooklyn Heights, R. R. Co.

MR. H. H. LITTELL: I move that the suggestion of Mr. McCormack be carried out and the committee appointed. Carried.

The meeting adjourned until 10 o'clock Friday morning.

FRIDAY'S SESSION.

PRESIDENT LITTELL called the meeting to order and announced the first business to be the reading of the paper on "The Selection and Management of Employés," by Mr. W. F. Kelly, general manager of the Columbus Street Railway Company, Columbus, Ohio.

The Secretary read the paper.

MR. SCULLIN: I would say that in connection with that part of the paper which relates to the furnishing of reading rooms, lavatories and sort of reception room for the men, our road took that step about a year ago, when we were building a new shed. We put in a nice waiting room for them, with a library containing a few standard works, and subscribed for some of the magazines. We also put in a gymnasium for them; not an expensive one, but provided with a punching bag, lifting machines, etc. In this way we can always find the men. When we want an extra man he is on hand, as there are always a number of them reading or exercising in the waiting room. We also provided a bathroom, with a shower bath, and in every shed we are now putting in these rooms. It is a splendid move and the men appreciate it; but, as Mr. Kelly says, it is not an act of charity—it is a duty we owe to our men. The street railway men will never regret having taken this matter up. In relation to taking a man off and making him lose a great deal of time, while I am rather a young man, at the same time I have given considerable thought to the subject. If you take the man off you take part of his livelihood away from him, and he is going to get it if he can. A better practice is to reprimand a man, not take him off; reprimand him once or twice; show him that you mean what you say, and the second or third time let him go.

MR. ROBERT McCULLOCH: We have three or four different gathering places for our men, and we have three rooms at each of three different places which we have equipped very nicely for the comfort and convenience of the men. One of them in particular is eighty feet square; it is heated by steam and lighted by electricity. The men have built a very nice stage and have organized amongst themselves, among other things, a sort of Thespian corps, and they give remarkably good performances of a theatrical character from talent among themselves. They have a piano and a dancing master who comes there, and they have dancing classes and bring their wives and daughters to them, and our hall is much in demand for the giving of entertainments by church organizations in the neighborhood. We give it to them free. The hall has done a great deal of good to keep the men out of saloons and to furnish them a place where they may have any kind of gatherings which they may desire. We exercise a control over their organization by having some of our officials as members of it, and prohibit any discussions relating to the affairs of the company or the relations of the men to the company. They may debate any questions they choose of a general nature. We allow no liquor to be served there in connection with their entertainments or with those that are given by others. We have kept the character of the place respectable and it has been running now about six years, and it has done a great deal of good. A great many of our men do not appreciate these things, but we don't feel that we have wasted any money.

MR. MAHONEY: I would like to get the views of some of the gentlemen present as to the custom of charging the employés with trivial accidents, breaking wagons, etc., whether they are to blame in the matter or not.

MR. H. H. LITTELL: The question of making a motorman pay for damages to a vehicle, etc., is probably a very serious one. On our system in Buffalo we sometimes make them pay a portion of the cost when we are convinced that it was the carelessness of the motorman that caused the accident, but in a great many cases, if, after investigation, we find he is not to blame, we pass it over. I think if they are careless and break a vehicle or injure a car, and you charge them with it, it is not so liable to occur again; but if a man continues to have accidents of that nature, it is a good thing to dispense with him before something serious happens. When we discharge a motorman for breaking a wagon or causing an injury to the car we do not deduct anything from his pay. In regard to rooms, I think that all well regulated street railway companies should have closets for their motormen and conductors; some place where they can hang up their rubber coats and put in their overshoes and heavy gloves, where they can change their clothing, if they desire, and these closets or wardrobes should be thoroughly ventilated. I think it is positively necessary to have a good place where the men can congregate and read, play a game of cards, so long as they do not play for money, smoke and have chess and checkers and any amusement that will keep them at the proper reporting place. We have nine such places. We have lavatories at all of our buildings and all the necessary conveniences.

MR. MUSSER inquired if Mr. McCulloch passed his employés free to and from his place of amusement at all times.

MR. McCULLOCH: Our employés ride free on their badges at all times.

MR. BENDURE: I find it a good plan to retain some of the wages of the employés to cover these minor accidents. Before I did that there was trouble all the time with the men getting too near buggy wheels. I made it a rule to retain $15 from each motorman and $10 from each conductor to cover damages to the property of the railway public, if they were to blame, and damages to trolleys under overhead switches. I have had the rule in practice now for ten months, and I have not had to deduct a dollar for these damages. They have almost entirely ceased. We run six cars, and in my brief experience I find it a good thing to do.

MR. LANG: We make it a practice to require the men to meet the expenses of accidents occasioned by their gross carelessness. If there is any doubt in the matter we decide it in favor of the employés.

MR. McCULLOCH: The question of fining a man or making him pay for damages is a very serious thing. We have not done that. If I think a man ought to pay for a damage or deserves punishment, I discharge him. We have in many instances offered a gripman or motorman the alternative of paying for a damage or giving up his place. That would be where a man had several small accidents. In some instances they have declined to pay and have given up their places; in others they have accepted the condition, paid the damage and retained their places, and we have very seldom had another accident from that same man. We have never both discharged a man and made him pay for a damage.

MR. H. M. LITTELL : In the company I am connected with all reports regarding accidents, dismissals and suspensions are put on the blackboard. When a man has been reported four or five times he is then warned. We have a book in which we make the entry of the date of a man's employment, and any record in regard to his references is kept in another book, every time a report comes in against him it is entered in this book, it does not make any difference what it is. When there are eight or ten reports against him the book is then handed to the superintendent, who calls the man, reprimands him, and enters in red ink "warned," with the date. Another eight or ten will come along and he is warned again. Probably that man's page will be filled up before he is warned three or four times, and then he is discharged. When he is discharged we never re-engage him.

As to accidents on our cable and electric roads, when a man has an accident he reports it at the end of the trip. He walks into the station and dictates the report to a stenographer. When he gets back on the next trip the report is written out and he signs it. He does not lose any time. This report is then sent to our claim department, and if the claim agent thinks it necessary to talk with this man he sends for him; he is called to the office. When he leaves the station the foreman gives him a card, for instance, "John Smith left the station at 9:10 a. m." He goes to our claim department, recites his case and the claim agent then indorses on this card, "Retained until 3:10 p. m.," or whatever time he was kept at the office. This goes back to the division superintendent and he O. K.'s it. If the man has been five hours away he is paid for it; if he loses one hour he is paid for it; if he loses a day he is paid for it. In that way we believe we get our men to report all accidents, even the most trivial incidents. It is the small accidents which give us the most trouble—accidents which, in the mind of the conductor, or gripman, or motorman, he would think, "Well, that is not worth reporting," and he says nothing about it. But the railroad company may hear of it in a month or two, or possibly a year or two, and these are the most difficult cases we have to defend, because we have no report and no witnesses. The conductor has gone or the gripman has disappeared. We talk to our men and try to impress upon them the importance of reporting everything. It does not make any difference if a man stubs his toe on the car, we want a report of it if the conductor knows about it. If a man falls off a bicycle alongside the track and there is a car approaching, we want a report. If a man stubs his toe on the street crossing and falls while a car is passing we want a report of that. With regard to rules, we have rules, but we believe we can do more with our men by getting them together and talking to them. Our gripmen and conductors have a club, called the Metropolitan Club, with such a large membership now that we are compelled to increase the size of their quarters. We finished a few days before I left home a room 120 feet long by 80 feet wide. They have a stage and piano, and the room is well lighted. We have in this room controllers, grips and other appliances; we have miniature cars and tracks, with the conduits exposed; we have broken grips. If a man should have an accident with the cable or the cable brakes we bring in the piece and show it to the men, and then tell them how to overcome it. We believe we we can do more by talking to them than by trying to reach them through a book. They have their toilet rooms, etc. We do not put them together. We have a conductors' room, a drivers' room, a gripmen's room and a motormen's room. They do not associate together at all. You will rarely see a conductor in the motormen's room, or a motorman in the conductors' room. They have their own lockers in the separate rooms, and have checker boards, tables, chairs and all that kind of thing.

About discharging men, I have a report come to the office every week, giving the number of men discharged on each division, and if I find that the division superintendents are discharging too many men I send to the stations and get the records of the men and find out the reasons. I am quite positive that there have been a great many men discharged unjustly for no good reason. Our foremen are as liable to make errors as the men are to make them. If a man is discharged we require that his complete record be sent to the main office. Sometimes it takes a sheet of paper, typewritten, a yard long. It makes our foremen careful, and they are not going to discharge a man for some trivial offense. We do not like to change our men. If a man does something which is not exactly right we talk to him, and we try to make it pleasant for him and keep him in our employ. The men are paid more wages the second year than they are the first. We believe that is some inducement for the men to stay with us.

MR. H. H. LITTELL: Our road is not as large as the one represented by the president, but we make a record of every complaint that comes in against either a conductor or a motorman, but we do not wait until there are four or five complaints against him; we call him down on every complaint, either by sending for him when he is off duty, so that he shall not lose any time, or sending a man to him to call his attention to what he is reported as doing, which is in violation of our rules, or which, in our opinion, is a violation of good judgment. I think it is due to the man that he should be told, if it is possible to do so, every time that he is reported. We punish our men a little differently, I think, from the methods pursued on most roads. I find if you have a man who has been on the road for some months and he gets a little careless it is a very excellent punishment to put him for one or two days on some other route, with some old motorman or conductor, as the case may be, and let him practice—"sub it," as we call it. It is the most effective punishment we have yet introduced. We apply this remedy for slight offenses, such as omitting to announce streets, failing to keep the platforms clear when it can be done, etc.

There was some further discussion on the subject of transfers, children's fares, and methods of checking conductors' collection of fares, but being in executive session, the matter was not issued for publication.

The meeting then passed a vote of thanks to the various bodies and individuals that had helped to make the convention a success.

THE PRESIDENT appointed as the Committee on Rules for Conductors and Motormen Messrs. W. F. Kelly, Columbus, Ohio; M. K. Bowen, Chicago, Ill.; E. C. Foster, Lynn, Mass.; Ira A. McCormack, Brooklyn, N. Y.; H. H. Vreeland, New York City.

Mr. McCulloch, the president-elect, was then escorted to the chair and made a brief address.

MR. DAVIS offered the following: "Resolved, That the secretary be instructed to obtain from the members of the association information and copies of municipal legislation relating to the imposition by their cities or municipalities of taxes or license fees upon the companies' property, franchises or receipts."

The foregoing was referred to the executive committee.

The meeting then adjourned, to meet at Niagara Falls on the third Tuesday in October, 1897.

CONVENTION NOTES.

THE ANHEUSER-BUSCH Brewery was the scene of the junket on Thursday afternoon, the party traveling on the Union Depot and Southern Electric cars.

A THEATER PARTY of about 150 enjoyed "In Gay New York" on Wednesday evening, when that giddy play had been besprinkled with gags for their special delectation.

COL. N. H. HEFT, president of the Meriden, Conn., Street Railway Company, has the distinction of being the first steam railroad man to become a member of the association. As a representative of the Consolidated System in New England he was asked innumerable questions as to the work at Nantasket Beach.

A TALLY-HO PARTY.—In honor of Captain Willard L. Candee, Mr. Pierre C. Gurneau made up a tally-ho party for the races. Captain Candee is considered one of the best whips in the East, and the manner in which he handled the ribbons amply justified his reputation. The party also included President Littell, of the association, Messrs. Brill, Price, McQuaide and others.

VISIT TO A NEWSPAPER OFFICE.—A number of the members who did not participate in the trolley car ride and entertainment at Forest Park on Tuesday afternoon, visited points of interest in the city. President Littell headed a party of some thirty gentlemen who wished to see a complete newspaper plant. They were shown through the "Globe-Democrat" building, and in spite of their thorough acquaintance with mechanical appliances marveled much at the wonders of a large newspaper office.

THE ATTENDANCE OF ACTIVE STREET RAILWAY MEN was not so large as hoped for, but there were no fewer than eighty different cities represented, and the personnel was of a very high order. The membership includes, as is well known, a great many men who are also actively interested in

supplies, and who may, therefore, be said to attend the convention in a dual capacity. The attendance and participation of the ladies was very gratifying, no fewer than 125 taking part in the excurisons and festivities. Of this number about half were visitors to the city.

A SPECIAL CAR RIDE.—On Tuesday afternoon at 2 o'clock the members of the association, with their wives, boarded the cars at Seventh street and rode to Washington avenue. There they found the special car "Rover" and three other nicely decorated cars of the Lindell line awaiting them. The party was transferred to the Lindell cars and taken to Forest Park. Arriving at the Lindell pavilion the party was served with light refreshments while a band played. After the refreshments the tables were cleared away, and dancing was indulged in. At 4 o'clock the party was driven through the park, Westmoreland and Portland places, and thence back to the Southern Hotel.

THE BANQUET.—The annual banquet on Thursday night was a grand success. Three hundred persons were present. The cuisine and floral decorations were all that could be desired, a superb orchestra discoursed music during the service of the dinner, and in some of the more familiar refrains the company joined in singing. About fifty ladies graced the occasion. The speeches, of which the following is a list, were exceedingly good: "City of St. Louis," Hon. Charles Nagel; "Welcome to Our Guests," Mr. F. N. Judson; "The Street Railway in the Courts," Mr. Smith P. Galt; "The Street Railway as a Social Factor," Mr. P. W. Lehmann; "The Press," Mr. W. M. Reedy; "The Technical Press," Mr. E. E. Higgins. Mr. J. H. Stedman acted as toastmaster.

THE JOCKEY CLUB was visited on Wednesday afternoon, when some good racing was enjoyed by a large crowd, and the visitors were singularly successful in their betting—probably because they had had no chance to get "sure tips." The road traveled over was the Citizens'. Over 300 male and female guests were carried on the other cars. Superintendent Whalen, of the road, was in responsible charge; Captain Robert McCulloch, general manager; Secretary C. N. Duffy and Engineer R. McCulloch being also on hand. These, combined with the regular entertainment committee, did everything in their power to add to the comfort and enjoyment of the guests. After refreshments at the Floral Hall in the Fair Grounds, the adjournment was taken, as described, to the races.

THE RECEPTION.—On Tuesday evening the local entertainment committee, consisting of Harry Scullin, George Rosenthal, Arthur Partridge, Joseph Franklin, Jr., John Whittemore and Scott Blewett, was in charge of the reception tendered to the visitors at the Southern Hotel. The ladies' ordinary and four large parlors were beautifully decorated with smilax, palms, roses and chrysanthemums. At 8:30 the doors of the small dining room adjoining the ladies' ordinary were thrown open, and a buffet lunch was served throughout the evening. The dining room was handsomely decorated and the shaded light from a myriad of incandescent globes shone upon tables banked with flowers, to which 125 guests sat down. Just outside the dining room and to the east of the open court, a mandolin orchestra of twelve pieces, concealed behind a bank of palms, discoursed music throughout the evening.

MR. JOHN G. BRILL in an interview with regard to the convention and exhibits said: "The supply men have made a special effort this year to make an excellent showing. It may be a surprise to many, but nevertheless it cost in the neighborhodd of $100,000 to bring these exhibits to St. Louis and put them in their present places. Of this amount the supply men expect to realize about $60,000 from special orders and the advertising resulting. That leaves at least $40,000 with the city of St. Louis, the association and the railroad companies. These figures are not at all exaggerated. My company alone is at an expense of $10,000, and it can be seen from the other displays how easy it is to run the amount up to $100,000. We have not only paid for floor space, but have established headquarters in the largest hotels and spent large sums in entertainment." Mr. Brill added that the St. Louis exhibit far surpasses any that the association has had in previous years.

EXHIBIT NOTES.

THE display of apparatus and supplies at the annual meeting of the American Street Railway Association always requires abundant space, from the very nature of the goods, and hence a large hall or floor area is necessary. This was found in St. Louis in the big, ramshackle barn of a building built and used for the Republican National Convention in June. It was most inconvenient as to location, being several blocks away from the hotel headquarters at the Southern, and was also very damp and breezy. To provide a meeting room a large space was boarded off in one corner, from which the noise outside was but poorly excluded. The main floor was not only well filled with cars, trucks, motors, etc., but the exhibits ran up the sides under the galleries. Current was furnished from an adjoining trolley circuit at 500 volts, and the building was well lit by a large number of arcs in the ceiling. The danger of fire was great; indeed, one incipient blaze is understood to have broken out, while owing to the broken condition of the floor the risk to limb was more than once demonstrated. However, with so large a display to be assembled and broken up again in so brief a space of time, probably the best was done that was possible. As there was plenty of bunting, the scene was bright, but the attendance outside those directly interested was quite small. One or two of the bulkier exhibits were left outside the building. Altogether, the show was far better than at Atlanta or Montreal, and reflected great credit on the taste and enterprise of the participants. Music was furnished by an excellent band, to which assistance was rendered by whistles and gongs in various exhibits. The attendance of members and supply men reached about 1,000.

BERRY BROS., of Detroit, showed a full line of varnishes suitable for varnishing car bodies.

EVANS & HOWARD, St. Louis, had a line of fire brick and earthenware goods, which included boiler tiles, flue pipes and stone sinks for power stations.

THE SIEMENS & HALSKE ELECTRIC CO., of America, were represented by Messrs. C. E. Yerkes and C. D. Shain.

J. A. McGRATH had a model of a flat car equipped with his patent brake. This model was placed on a short inclined railway and loaded with heavy weights.

STERLING SUPPLY AND MANUFACTURING COMPANY, New York, showed their well-known registers and brakes. Mr. J. J. Kennelly looked out for their interests.

THE DEVLIN STEEL CAR BRAKE COMPANY, Memphis, Tenn., showed a model of their power and safety chain brake. They also exhibited a new trolley wheel in three sections.

THE BENEDICT & BURNHAM MANUFACTURING CO., of Waterbury, Conn., were represented by Mr. E. H. Oswald, who had samples with him of trolley feeder wires and solid one-piece rail bonds.

THE H. B. CAMP COMPANY, Aultman, Ohio, had on view specimens of their vitrified clay conduit, suitable for telephone, telegraph, street railway, lighting and power purposes. Mr. A. L. Daniels was in charge.

MR. EDWARD P. SHARP, of Buffalo, was in attendance at the convention, and had a list of bargains in second-hand apparatus at very attractive prices to offer to any one interested in procuring electrical apparatus cheap.

THE SECURITY BANK NOTE COMPANY, Philadelphia, had a complete line of engraving work which included a large variety of street car tickets, street railway bond forms and passes. Mr. G. S. Hall represented this company.

THE SAFFORD & MOORE RAILWAY JACK COMPANY, Chicago, showed some of their rapid tripping track and car jacks. Mr. M. M. Moore, vice-president, and Mr. N. K. Williams, secretary and treasurer, looked after the interests of the company.

THE ELECTRIC INSULATING COMPANY, of St. Louis, represented by S. J. Stein and L. Honig, showed samples of their "Peerless Armature" compound, suitable for armatures and fields, for painting switchboards, poles, conduits, lamp hoods, etc.

MR. GEORGE F. REARSEN, manager of the National Jack Company, Boston, was around showing his device, and judging from the number of those who called at his interesting exhibit it is very probable that they will be used on many more street railways before long.

LESCHEN-MACOMBER-WHYTE COMPANY, of Chicago, showed samples of iron, steel and copper wire, wire rope, black manilla transmission rope, galvanized span wire and overhead line material. They were represented by Messrs. F. B. Macomber and George S. Whyte.

THE FITZGERALD VAN DORN CO., of Chicago, showed two of their No. 5 couplers on two small flat cars, two of their No. 7 couplers, and also the No. 4 coupler, which is used on the Metropolitan Elevated Railway, Chicago. Mr. W. T. Van Dorn had charge of the exhibit.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, were represented by G. R. Scrugham. They showed the Creaghead flexible brackets, overhead line material, malleable iron cross arms, a full line of fittings for iron poles, and the Manhattan arc lamps. These were shown burning five in

series on a street railway circuit, and were of the well known inclosed arc type.

MR. EZRA H. LINLEY, of St. Louis, had a well filled booth, with specialties of the following companies: William Joseph & Sons, Nathan Manufacturing Company, Midvale Steel Company, Morris, Tasker & Co., Detroit Steel and Spring Company, Cambria Iron Company and other leading manufacturers of engineering specialties.

THE ADAMS AND WESTLAKE COMPANY, of Chicago, were represented by H. E. Keeler, W. S. Bartholomew, F. B. Jones and L. A. Gray. They showed samples of their Acme curtains for closed and open cars, gravity ratchet brake handles, arc lamps, and a general line of car trimmings, headlights, chandeliers and everything connected with car equipment.

WOODS' PATENT CAR GATE was shown by Mr. C. Kinne, who represented the R. Bliss Manufacturing Company, Pawtucket, R. I., who are the sole makers. This gate is very simple in construction, and when opened full or closed it is kept securely in place by means of a double acting spring lock. These gates are used on quite a large number of street railroad cars throughout the country.

THE FOREST CITY ELECTRIC WORKS, of Cleveland, O., were represented by Messrs. Cleveland and Dolph, who had an admirable display of their copper specialties. There was an enormous demand for their handsome embossed portrait of Mr. McKinley, stamped in copper and gold, and bearing appropriate legends as to the golden protection afforded by copper bonds of the Forest City make.

THE NATIONAL CARBON CO., Cleveland, Ohio, had a handsome exhibit, in which they showed a full line of the different styles of carbons manufactured by this company, amongst which they included a large assortment of brush carbons, planed down to exact dimension. They had also a fine line of carbons for telephones, which were very tastefully arranged. Mr. M. M. Hayden and R. P. O'Connor received the visitors to this exhibit.

THE KINZER & JONES MANUFACTURING COMPANY, of Pittsburg, Pa., had some sets of their different makes of brake shoes, suitable for steam and street railways. This company claim that by using these shoes with the connections commonly known as heads or hangers it is impossible "to lock the wheels," thus preventing the wheels from skidding, sliding or wearing flat. A neat model of a Wagner composition filled shoe was presented to visitors as a souvenir.

W. H. COE MANUFACTURING COMPANY, Providence, R. I., showed their gilding wheel. This machine is very simple, the gold or silver leaf being put up in different widths, like ribbon, with paper backing, in the upper flange wheel of the machine and connected with a lower belt, which is slowly rolled over the surface to be gilded. The leaf leaves the paper and adheres to the sizing. These wheels are used by several of the prominent street car companies. Mr. W. H. Coe had charge of the exhibit.

JEWELL BELTING COMPANY, of Hartford, were represented at the convention by C. L. Newton, secretary; A. E. Silk, general traveling agent, and W. G. Wheelock, Western agent. They showed a handsome sample of their celebrated belts for transmission of power, the exhibit being in charge of Mr. Silk, who represents the Jewell interests throughout the entire country, and is thoroughly capable of earning the entire confidence reposed in him by the company. Mr. Newton had some amusing experiences to relate in regard to elephant and rhinoceros hide.

J. M. ATKINSON & CO., showed a full line of their horseshoe flexible rail bonds, which are already well known. They also exhibited the Waterman rail drill, which is suitable for steam and street railways. This drill is easy to work, as it is geared so as to operate by turning one way only, and is held in place on the rail by two clamps, which can be collapsed when trains pass without taking the drill tool out of the rail in which the hole is being bored. This company also distributed a small X-ray souvenir, for which there was considerable demand. Messrs. J. M. and F. Atkinson were in charge of the exhibit.

THE OHIO BRASS COMPANY, of Mansfield, O., had a handsome exhibit of pyramidal form, in which were displayed samples of their line material, consisting of hanger bodies in a great variety of forms, eight different styles of trolley ears, complete line of material for hanging figure 8 trolley wire, and all forms of section insulators and cross-overs, steam insulators, rail bonds, feeder wire insulators, feeder wire splicers, flexible pole brackets and everything pertaining to overhead line construction. They also showed their adjustable track brush holders and brushes. A few samples of their pure bell metal bearings were also shown and the whole made a very complete and attractive exhibit. The company was represented by Mr. C. K. King, secretary, and A. L. Wilkinson, special agent.

THE CONSOLIDATED ELECTRIC PURIFIER CO., Chicago, exhibited one of their automatic electric feed water purifiers. It consists of a cylinder with a series of electro positive and electro negative plates, through which there is a water passage, the feed water passing through and over the plates, separating the various deleterious ingredients, while their affinity for the iron of the boiler is destroyed, as no one ingredient can form scale by itself. It delivers to the boiler a non-scaling water. This being accomplished, the old scale, if any, on the boiler will, from the action of the water, rot, and with the expansion and contraction of the boiler iron gradually drop off, the work being done entirely without the aid of purges or compounds of any kind. Mr. C. E. Whitmore, the president and general manager, explained the working of the purifier to the numerous callers to his exhibit.

A COMBINATION EXHIBIT.—The combined exhibit of the Lombard Hydraulic Brake Company, the Steel Motor Company and the Dupont truck attracted the attention of the delegates. The brake principle involved is the same as in the Lombard water wheel governor, and is the invention of the same man, Mr. Nathaniel Lombard. The fact that oil is the medium used to operate the brake and covers all working parts renders the work of maintaining the pressure extremely simple. The amount of oil used can be so nicely controlled by the patented device for closing the valves attached to the brake piston that the motorman can apply as much power as is required to stop the car easily or very suddenly. The company have made improvements in the method of supporting and driving the pump and connecting the same with the brake piston, pressure and exhaust tanks. They now attach the pump just as a motor is hung upon the axle, and drive it by gears. They had also a separate motor-driven pump, which can be had if desired. Mr. Daggett was in charge of the exhibit.

THE GENERAL ELECTRIC COMPANY was represented at the St. Louis Convention by an exhibit which embraced the newest developments in the electric traction field. The space occupied was the most extensive in the hall and was located immediately to the left of the entrance. The exhibit comprised examples of the standard apparatus of the company's manufacture, as well as the latest devices developed since the last convention, and Street Railway delegates and visitors found that every item had a special interest to them and to their work.

A G. E. 1,000 motor equipment was mounted on a truck and was shown in operation with the electric brake. One of the Brooklyn Bridge car trucks was exhibited equipped with two G. E. 2,000 motors and near by examples of the G. E. 800, 1,000, 1,200 and G. E. 51 types of motors. The controller section included examples of the K 10, B 6 and L 2 controllers, as well as one of those used to handle the great 96-ton electric locomotives of the Baltimore & Ohio Railroad. A switchboard made up of generator and feeder panels with full equipment of standard instruments, rheostats, etc., was also installed. Lightning arresters were shown in operation, and the magnetic blow-out device and the operating principle fully explained.

A G. E. 1,000 armature with one-half of the coils in place showed the method followed by the General Electric Company in the construction of its railway motor armatures. An electric brake adapted to trailer use, with shoe and disc, served to explain the electric brake and its principle.

The branch of electric railway supplies was represented by a series of ten Thomson railway arc lamps in operation, as well as some fine examples of the long burning type of lamp adapted to street railway use; assembled commutators of G. E. 800, G. E. 1,000 and G. E. 2,000 motors, bound solid for shipment, were also shown in connection with samples of the new frogs and overhead switches and trolleys. K and L types of circuit breakers, and the new M automatic circuit breaker for street railway car equipments, and a fine exhibit board of punched clip switches completed the display of the supplies.

The work of the company in the steam railroad field comprised a sample section of the third rail in use on main line of the New York, New Haven & Hartford R. R., a direct connected air-pump with automatic governor used on the cars operating on the same railroad, and a section of the overhead contact device used in the Baltimore & Ohio R. R. work.

The exhibition space was illuminated by miniature incandescent lamps and decorative signs.

The headquarters of the General Electric Railway Company were located in the two parlors in front of the dining hall of the Southern Hotel. The company was represented by members of their staff from New York, Schenectady, Boston, Philadelphia, Chicago, Cincinnati and St. Louis, under Mr. W. J. Clark, and numbering over twenty.

THE MEAKER MANUFACTURING COMPANY, Chicago, had an exhibit of portable and stationary street car registers, and also a line of overhead material. The exhibit was taken care of by Mr. J. W. Meaker.

KROTZ, ALLEN & KELLY, Springfield, Ohio, distributed a very neat souvenir, which consisted of four small pieces of cardboard, fastened together with red ribbon, on which were shown views taken last winter of the K. A. K. system of underground conduit made by this concern.

THE CONSOLIDATED CAR HEATING COMPANY, Albany, N. Y., had a new line of their well-known electric car heaters and temperature regulating switches. They also showed some of the smaller heaters in place under Scarritt cross car seats, the whole making a very neat exhibit.

THE ST. LOUIS REGISTER COMPANY had on exhibition some of their security registers of different grades. Amongst those shown were two with mechanism exposed to view, and the visitors to the exhibit were able to see for themselves the way in which the correct number of fares on each street car trip can be kept count of.

THE AMERICAN STEEL FOUNDRY COMPANY, St. Louis, had on view some specimens of basic steel truck frames, basic steel castings, drawn out under hammer, straight and twisted, also a basic cast steel bolster. This exhibit was located in the gallery, the castings reposing on a large cover with blue and red stars, and large and small red, white and blue stripes, the national colors.

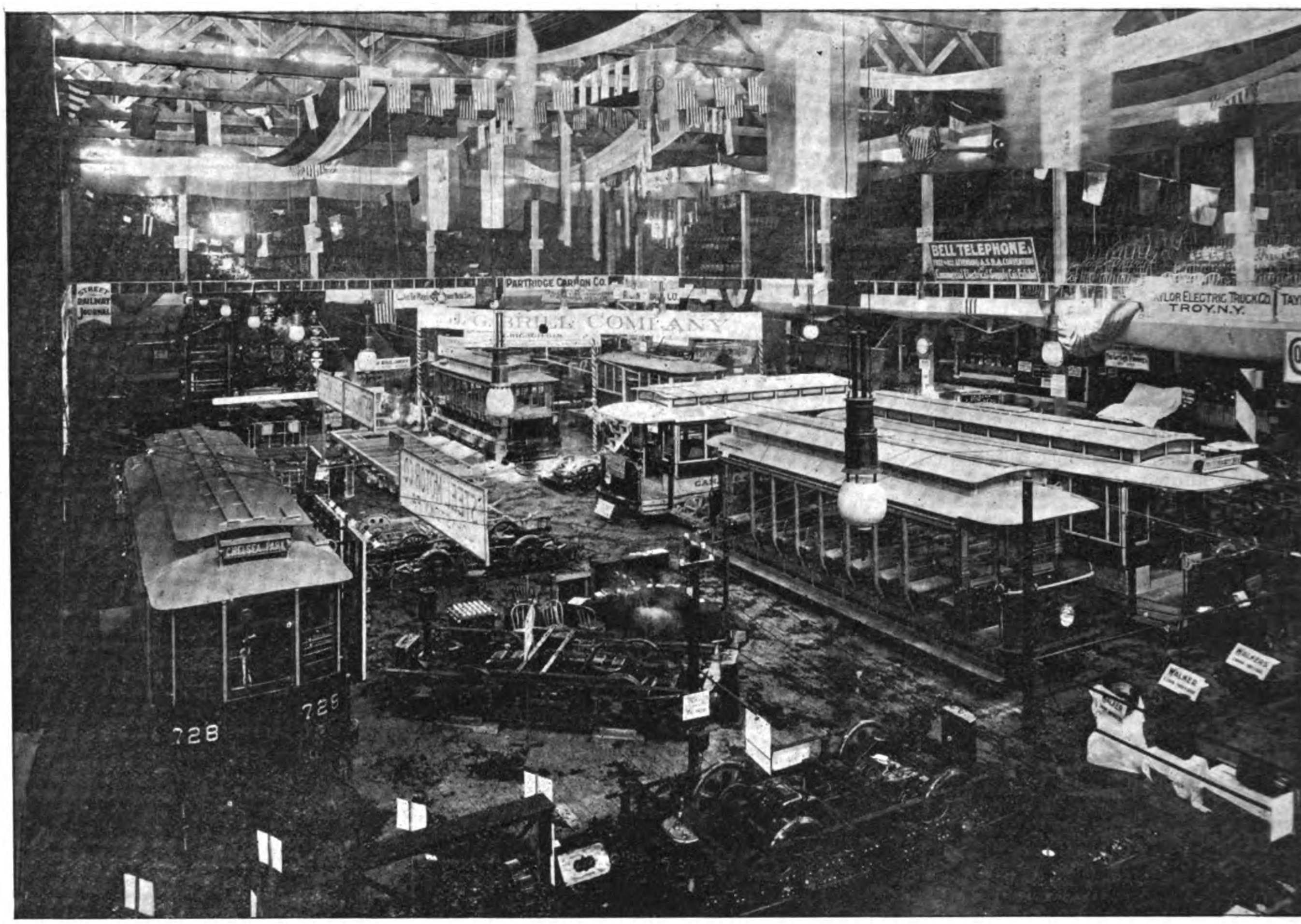
THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, was represented by Mr. Charles P. Platt. This company showed one of their new type 100 drop switchboards, fully equipped; also a number of samples of telephones and other apparatus of this description, manufactured by this progressive company. This exhibit attracted considerable attention owing to its tasteful arrangement.

THE INTERNATIONAL REGISTER COMPANY, of Chicago, was represented by Mr. A. H. Woodward, treasurer and manager, and Mr. A. H. Englund, secretary. This company had a complete line of their portable and stationary registers. Amongst the latter was shown their new double register for cash fares and transfers, which attracted considerable attention.

THE AMERICAN CAR COMPANY, of St. Louis, had an excellent display, under the supervision of its president, Mr. W. Sutton, one of the pioneers of car building in the West. It consisted of three cars in the latest style of the art, one being a double truck and two single trucks. There was also a high speed motor truck specially intended for high speed suburban work. The olive bodied car built for New Orleans elicited very favorable comment.

THE MISSISSIPPI GLASS COMPANY, St. Louis, had a line of fire brick suitable for high grade boiler and furnace work. They also showed a fine line of Florentine glass, to be used for deck lights, for street car work, and for all kinds of glass partitions. A unique part of this exhibit consisted in some specimens of their wire glass, in which a strong metallic netting is embedded in the glass. This is done while the glass is in a molten state, and when the glass is ready for use it adheres so firmly to the wire that if broken by shock, by fire, or from other causes it remains practically intact, as, although the glass may get cracked all over, it will still firmly adhere to the wire netting unless a force sufficiently severe to break the netting is used. The manufacturers of this glass claim that it is practically fire and burglar proof, and can be advantageously used for quite a large variety of purposes. Mr. Charles W. Parker had charge of the exhibit and received a large number of interested callers.

THE PECKHAM MOTOR, TRUCK AND WHEEL COMPANY had an extensive exhibit, as usual, with Mr. Peckham directing it. In the exhibition hall there were a No. 7 C Excelsior truck, one of 175, now building for the Cincinnati Street Railway, and fitted with the Kilgour emergency brake and General Electric "No. 1,000" motors; an extra long truck, with Walker No. 10 motors; another similar with Westinghouse No. 12 A motors; another with General Electric "No. 1,000" motors, and one with Westinghouse No. 38 B motors. There were also an "extra long" truck under a 20-foot closed car body; a No. 14



EXHIBITS AT THE STREET RAILWAY CONVENTION, ST. LOUIS.

double-cushioned swivel truck, and a "standard" No. 8 A truck with new type extension trusses. In operation on the street railway systems the company showed a pair of No. 14 trucks under a Jackson & Sharp 35-foot vestibuled combination car body, with the bottom of the sills only 27½ inches from the ground. This was fitted with General Electric No. 1,200 motors and Hunt airbrakes. Mr. Hanna was in general charge of the whole exhibit, and maintained hospitable parlors also at the Southern, besides distributing a large quantity of literature.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, had one of their large converters on exhibition in the space of the Commercial Electric Supply Company and Mr. E. H. Abadie was in attendance at the hall and the hotels to meet his numerous friends.

K. McLENNAN & CO., of Chicago, through their indefatigable agent, Mr. Isaacs, issued a large number of State warrants in the case of the company versus users of generator and motors. Messrs. Sparking and Cutting were arrested by one application of Gale's commutator compound.

THE NEW HAVEN REGISTER COMPANY, New Haven, Conn., exhibited a line of their single, double and triple street car registers. Mr. A. N. Loper, their traveling salesman, was in charge. Mr. F. C. Boyd, vice-president and general manager, and Mr. Willis Anthony were also around.

FLETCHER & STONE, of St. Louis, showed an automatic cut-out for releasing a broken trolley wire, so that should the trolley wire break, it immediately becomes dead. They also showed a flexible hanger, the object of which is to overcome the crystallization of the trolley wire where it enters the cars.

MR. F. W. DARLINGTON, E. E., of Philadelphia, distributed an attractive pamphlet entitled, "Electric Illuminated Fountains," dealing with his work at Willow Park, recently illustrated and described in The Electrical Engineer. He has been making a specialty of this in connection with electric railways, to whose pleasure parks is thus added a highly popular and remunerative feature.

MR. ARTHUR S. PARTRIDGE, of St. Louis, had a tastefully decorated booth, in which were displayed a full line of the specialties of R. D. Nuttall & Co., of Allegheny, Pa. Mr. Partridge represents a number of other interests in the West, whose exhibits were in various parts of the hall, and were complete in themselves.

W. W. DOTY & CO., of New York City, exhibited the Doty-MacKnight automatic track switch for electric surface roads. The switch consists of a double solenoid mechanism and a current reversing switch, all being contained in a box placed in the track bed under the switch tongue. The box is about three feet deep, and eighteen inches wide. The section of track immediately adjacent is insulated and the operating current is applied from the line through the controller. All the wearing parts are of heavy, solid metal. On approaching the switch, if the motorman sees that the tongue is right for him, he shuts off his current, allowing his car to skid over the insulated section. If the tongue is over the wrong way for his direction of travel he leaves the current on and the switch is at once thrown across.

THE STEEL MOTOR COMPANY, of Johnstown, Pa., were represented by George W. Henry, general sale agent, 1,505 Monadnock block, Chicago, and Eug. C. Parham, electrician of the company. No exhibit attracted and held more attention or excited more interest than that of the company. Mounted on a Dupont truck, now winning much favor, for its simplicity and durability, were two C No. 3½ steel motors, operated by two C No. 3 controllers. The C 3½ motors are the latest, tested and tried production of these pioneer makers of steel motors. The motor is constructed upon substantial lines, has never failed to convince the most skeptical street railway man of its staying powers and durability, and enjoys the distinction of offering easy access to any one part without disturbing any other. The C No. 3 controller is of the series parallel type, with the usual locking and interlocking devices, but has the "unique" feature that the motor cut-outs are incorporated within the control of the reverse lever, making it unnecessary to open the controller to cut out a motor. This innovation seems to have been indorsed by technical admirers and by the many practical motormen who availed themselves of the opportunity to witness and also try its operation. The steel motor exhibit was a "hit," and its businesslike, "get there" aspect created a favorable impression.

THE J. G. BRILL COMPANY had a superb exhibit covering a very large section of the main floor, and illustrating the great versatility and resource of that celebrated concern. One of the leading features was an open car on the No. 21 E truck, and having a specially designed curved panel for the seat ends, the object being to render ingress and egress easier. Another 21 E truck was shown unequipped; also the latest maximum traction truck, which enables a double truck to be dropped low enough to permit of using only one step. No. 27 truck shown is a new departure in electric car service, for high speed work, and is of the style used as a standard by the Buffalo-Niagara Falls road, the Akron and Cleveland, the Cleveland, Painesville and Western and others. The idea is that instead of having the springs lining with the track they are carried outside. A remarkably flexible truck is gained by this method of disposing of the spring links. Owing to the increased speed of the links there is a greater stability of the car body. The car has less inclination to roll, the passengers have less difficulty in dismounting and more pleasure while riding, and the mechanism is far less liable to feel strain or shock. It is evident that with so many springs and equalizers the car motion must be very easy. It is said that sixty miles an hour is made comfortably. There were also shown a snow plow for cleaning snow off double track, a sweeper with separate motor on the rotary brooms and a sprinkler with a capacity of 3,200 gallons. The company had also a parlor at the hotel for their friends, and were represented by Vice-President J. G. Brill, Assistant General Manager S. M. Curwen, F. C. Randall, W. H. Hulings and G. M. Haskell.

THE STANDARD AIRBRAKE COMPANY, of New York, represented by Mr. E. J. Wessels, their general manager, and by Mr. Merriam, their engineer, had a splendid exhibit of their system, which, distinctively a pioneer in the application of power brakes, remains to-day a highly progressive leader in this important field. The exhibit included their apparatus as it exists in its latest forms and as illustrated in the special types built for the Cleveland and Akron road and for the Leipzig, Germany, street car system. A most fascinating exhibit was that which, in contrast with their single-acting and geared types of compressors, was devoted to exhibiting their electric motor compressor. This is used in conjunction with a very ingenious and simple automatic controlling device, which, within the predetermined limits, takes care of the maintenance of the air pressure, and sets the motor to work, compressing the moment the single needle dial on the brake handle stem shows the lower limit, cutting off the trolley circuit to the motor the moment the compressor is again at the right point of charge. Nothing prettier or more convincing to watch could be imagined. Associated with the exhibit were some decidedly effective whistles, while the whole space was railed by brake handle standards, as placed on the platforms against the dashboards, and connected up by the couplings and pipes used for hitching on trailers so as to make the braking effective and instantaneous throughout the train. The company had some pithy and pointed literature to distribute, including its latest catalogues and the well-known discussion of the subject by Mr. Wessels, a paper which still serves as an arsenal of formidable and irrefutable arguments for power braking on street railways.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.—The exhibit of the Westinghouse Electric and Manufacturing Company was in the midddle of the hall, where this well-known company had a display of motors, switchboard apparatus and sundry literature. Among the motors, the No. 12 and 38 B, mounted on Peckham trucks and on a Brill Company snow sweeper attracted general attention. The particular novelty, however, of the Westinghouse exhibit, and from an electrical point of view, the most interesting part, it might be said, of the entire exhibition, was the display of Wurts switches and circuit breakers. These appliances are of recent design, and embody some very novel features of improvement, which strongly appealed to the practical men, who manage the power house, and who are engaged in the operation and attendance of the generators and switchboards. The chief characteristics of the switches, which were especially commented upon, were their enormous carrying capacity and ease of operation, as compared with older types. The company manufactures these appliances up to 3,000 ampere capacity. The circuit breakers are of equally easy operation. They have copper carbon shunts, preventing all possibility of burning at main contact points. It has a releasing device without the use of the solenoid. Means of adjustment are sliding weights over scale arm. These instruments were shown on a two-panel switchboard, one being a 2,000-ampere generator panel, and the other a 1,200 feeder panel. In addition to these instruments the exhibit also contains samples of the well-known Wurts non-arcing lightning arresters, tank arresters, as well as pyramidal arrester for high potential transmission circuits. The company was represented as strongly as on any previous convention, those present being G. H. Lewars, Albert Schmid, W. F. Zimmerman, C. E. Bragg, A. J. Wurts, H. P. Davis, A. Hartwell, J. A. Rutherford, C. E. Skinner, T. A. Cleland, H. C. Ebert, M. Coster, W. R. Brown, A. F. Gordon, N. W. Storer and E. H. Heinrichs.

THE WELLS & FRENCH COMPANY, of Chicago, exhibited their "Chicago" truck.

THE CROCKER-WHEELER ELECTRIC COMPANY were represented my Mr. H. L. Lufkin.

LINBURG, SICKEL & CO., of Trenton, had on the main floor one of their Trenton trolley wagons of the standard make, now familiar to the street railway public.

WENDELL & McDUFFIE, of New York City, well known for their street railway specialties, were represented by both the young and energetic members of the firm.

IVES AND MACCLERNAN, of Baltimore, represented the Leonhardt Wagon Manufacturing Company, and had three of their excellent revolving tower wagons on view, illustrating different sizes and other features to great advantage.

THE STORAGE BATTERY COMPANY OF AMERICA were well represented by Messrs. Lloyd, Condict, Williams and Arnold. The deep interest taken by railway managers in the battery as a part of station and line equipment sufficiently explains the presence of such a strong force.

FORD & BACON, engineers, of New York City, were represented by Mr. Ford, who was able to show one of the cars built under their specifications by the Amer. Car Company for the Canal & Claiborne Railway Company of New Orleans, one feature of these being the 2 inches greater length given to the cross-seats by means of the style of end panel adopted.

THE MARK RAILWAY EQUIPMENT COMPANY, of Chicago, represented by C. E. Mark, president, showed their excellent joint bridges as applied to the rails of a large number of well known roads. The support given to the rail, especially as it reinforces the head and beam can result only in greater durability and smoother running.

THEBROWNELL CAR COMPANY, of St. Louis, had a large car on view, unusually high, having a flight of three steps. It is intended for the Metropolitan road of Kansas C'ty and will stop at platforms, hence its great height from the ground. A special feature is the opening and closing of the gates by means of a small handle on the motorman's right side close to the dashboard. The car was a beautiful type of its class. It was supplemented by a light Brownell car truck.

THE WHITE-CROSBY COMPANY, represented by Mr. Hugh Harrison, had a remarkably interesting exhibit—none other than a full size head, of one of the Niagara-Buffalo pole lines that they are building; an article on-which appears elsewhere in this issue. The pole carried its regular cross-arms, with Imperial porcelain three-cup insulators, American Electrical Works bare copper wire, guard wires, fuse wires and provision for telephone service. The cross-arms were also shown properly braced and all the details were faithfully carried out.

THE KRAUSHAAR LAMP AND REFLECTOR COMPANY, of St. Louis, had a magnificent exhibit in the shape of a mammoth board draped in dark cloth, on which were grouped in a most clever and artistic manner a number of designs and trophies, all built up out of street railway material, chiefly brass. The effect was simply superb. Stars, crescents, shields, tendrils, borders, flourishes dazzled like gold, and it was amusing to note on close inspection that plain, ordinary brake handles, window lifts, hinges, scrolls, lock escutcheons and other familiar parts were all that the ingenious artist had had to work with.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, of Cincinnati, was unable to make its intended exhibit owing to sickness in the family of Mr. S. J. Wick. The company was, however, worthily represented by Mr. E. P. Morris, New York agent, and by Mr. W. R. Mason, of the Mason Electric Equipment Company, Chicago agent. This company is making a specialty of electric railway supplies, and its manufacturing facilities are such that it is enabled to furnish everything used either for the equipment or maintenance of such roads. The most careful and exhaustive tests for strength and insulation are made, and as a result the company is enabled to guarantee all material.

THE AMERICAN CAR COMPANY'S car, containing the "H. W. J." electric heaters, was notable as illustrating several other novelties, such as the new cane seats and seat stands of the Scarritt Furniture Company and the National airbrake, which depends only on the car for its power and makes no draft on the line. Another feature which is certain of universal adoption before long, was that of the electric push button to each seat, so that the passenger has no trouble in signaling the conductor when wanting to get off. In this case the pushes were mother-of-pearl, mounted in nickel rims. The provision of such luxury evinces of a liberal management that draws travel where a parsimonious management repels it.

MR. EDMOND VERSTRAETE, a well known railway pioneer, and now president of the Missouri Brass Type Foundry Company, of St. Louis, had on exhibition on one of the fine steel trucks of the St. Louis Car Company, his improved electric brake, which works on current from the line, brought through an asbestos boxed resistance and energizing a solenoid magnet, the pull on which instantly sets the brakes, by means of a chain communicating from the magnet to the brake bar. The magnet is small and is placed under the front part of the car. It will lift 1,200 pounds from the ground, and hence will be seen to have a very positive action when operating a brake. The brake chain and plunger run in a graphite casing inside the solenoid. Some of these brakes are in use on the St. Louis Suburban.

THE H. W. J. ELECTRIC HEATER, made by the H. W. Johns Manufacturing Company, was shown in a full equipment in a beautiful car made by the American Car Company, of St. Louis. These heaters, which have already been described in The Electrical Engineer, were placed longitudinally against the sides of the car. These heaters need only screws to fasten them to the woodwork, and, being very flat, literally occupy no space, while the principle of multiplicity provides that general distribution, which is so necessary, but which no stove can give. The company also showed in connection with this set one of their switches for throwing the current on and off the heaters, so arranged as to lock at each step, and being remarkably compact and correct in its design. The company had an exhibit in another part of the hall of its heater arranged to go crosswise under seats. The literature distributed was pithy and to the point, and the company were most energetically and intelligently represented by Mr. J. Emery Meek.

THE WALKER ELECTRICAL MANUFACTURING COMPANY had a well selected and representative exhibit on the main floor, under the care of Mr. J. Holt Gates, of Chicago, and Mr. W. J. Davison, engineer of the company in Cleveland. One of its main features was the type of armature for the fifteen generators ordered by the Chicago City Railway Company, each of 800 k. w. These are to be rope-driven at 220 revolutions. They are 10-pole machines, with 40 brushes and 3 bearings, and weigh 61 tons complete. The exhibit included also one 75 h. p. railway motor (3,000 pounds drawbar pull), one 50 h. p. (2,000 pounds), one 35 h. p. (1,200 pounds), one 25 h. p. (800 pounds). The controllers included also the new type E 1, the feature of which is that the current is broken up in 28 points, by means of a separate cylinder, instead of using a magnetic blow-out. It has also a separate reversing and controlling cylinder. Armatures for the various types of railway motors were also shown, and the exhibit was rounded out with a handsome Peckham truck equipped with two 25 h. p. motors; as well as by a run of overhead wire fitted with the new Walker overhead pull-overs, ears, clamps, etc., and the interesting and ingenious Walker roller trolley adjusted to show how it runs under a switch.

THE CENTRAL ELECTRIC COMPANY, with the co-operation of its healthy St. Louis concern, the Southern Electrical Supply Company, made an exhibit which was surpassed by none for taste and comprehensiveness, and which was for its space decidedly the prettiest in the building. It had a large booth all draped and roofed with the Stars and Stripes, and neat fence around, with railings, on which some of the goods were placed. There was a brilliant setting of colored incandescent lamps, accentuated here and there by headlights of dazzling ray. The walls of the booth were lined by a generous collection of railway material, all grouped and posed to secure the greatest artistic effect. Among the special decorative panels may be mentioned one of the ingenious and effective Garton arresters, another showing Billings & Spencer railway specialties and copper goods, one of mica for electrical purposes, one of a neat group of the Partridge carbon brushes, one of the interior conduit system, and one showing in array the Bound Brook trolley, motor and other graphite bushings. These were all set off by lamps and made an effective combination. There were also shown a table of samples of Okonite cables and feed wires and a section of the new interior conduit insulating subway pipe. Two lighting novelties drew the attention of everybody. One was the detachable lamp for cars made by the Changeable Headlight Company, so made that one light would serve for both ends of a car, being transferred to and from boxes into which the headlight slips and locks. The change is made positively and easily in a single moment. Each box, when not occupied by the lamp, is closed by a little flanged lid. The other lighting device is the new Benjamin weatherproof and waterproof socket, made in three styles. Its mechanism is simple and its use on such exposed places as the platforms of the Chicago Metropolitan stations, shows how thoroughly it can be depended on. The Central Electric Company were vigilantly represented by Messrs. W. R. Garton, E. E. White, Malcolm McNeill and C. W. Cobb.

HALE & KILBURN, of Philadelphia, showed a full line of their well known seats and chairs for the equipment of street cars.

THE CONSOLIDATED CAR FENDER COMPANY had a full sized model of a car fitted with their car fender at both ends.

MR. C. D. SHAIN was present in the interests of the Siemens & Halske Electric Company, and the Weston Instrument Company.

THE JOHN STEPHENSON COMPANY had no cars on view, but distributed to their many friends a neat vest pocket memorandum book.

THE SCARRITT FURNITURE COMPANY, of St. Louis, had a very handsome exhibit of their various designs in car seats, chairs, reversible seats, etc.

MISSOURI MALLEABLE IRON COMPANY, of St. Louis, showed a few samples of castings for railway fittings, such as drawbars, axle boxes, truck frames, etc.

J. H. WOLF & CO., of St. Louis, were represented by Mr. Wolf, who interested delegates in a new transfer ticket which is easily read, and avoids all danger of disputes.

THE POND MACHINERY COMPANY, of St. Louis, exhibited a full line of their celebrated steam separators for furnishing dry steam to engines in electric light and power plants.

THE SARGENT COMPANY, of Chicago, were represented by Mr. E. L. Adreon, who showed a few interesting samples of brakeshoe, and other steel castings for street railway purposes.

E. M. DAVIS, of St. Louis, showed a working model of his automatic switch thrower, by which the switch can be flung automatically in any direction by a mechanical device set in front of the motorman.

THE MISSOURI CAR AND FOUNDRY COMPANY, of St. Louis, were represented by Mr. James Connolly, who had on exhibition car wheels, cable pulleys, chilled brakeshoes, brasses and other street railway fittings.

L. A. CHASE & CO., of Boston, were represented by Mr. S. B. Condit, who had something interesting to say on the subject of repairs. Mr. Condit was and is looking for a few good specialties to represent in the East.

THE CRANE COMPANY, of Chicago, were represented by Mr. J. B. Berryman and G. A. Hurd, who had an interesting exhibit of valves and fittings for high pressure work, suitable for the equipment of street railway power plants.

BRADFORD BELTING COMPANY, of Cincinnati, were represented by Mr. O. M. Hubbard, who showed samples of Monarch paint, and other electrical specialties, for which they have become well and favorably known in the West.

THE ROCHESTER CAR WHEEL WORKS were actively represented, as usual, by Mr. Russell, who had with him as a souvenir something that would very effectively remind the friends of the works that their wheels are true as steel.

ELMER P. MORRIS of New York, representing Monarch insulating paint, and general electric supplies, attended the convention and distributed also a large number of samples of Monarch war paint for internal use, put up in small glass barrels.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., were represented by Mr. P. C. Ackerman, of New York, and F. E. Donohoe, of Chicago, who said that their exhibit was all over the city in the shape of feeder wire in actual service.

SHICKLE, HARRISON & HOWARD IRON CO., of St. Louis, were represented by Mr. James Daniels, secretary of the company, and T. M. Gallagher, vice-president. They showed samples of their steel gears for electric railways and all classes of steel castings for cars and truck frames.

THE WATERTOWN ENGINE COMPANY, of Watertown, N. Y., were represented by the Pond Machinery Company, of St. Louis, and showed model of their electric light engine governor and called special attention to their exhibit of engines in operation in the St. Louis Exposition building.

D. C. SWEET, of Springfield, Mass., showed two styles of his car wheel grinder, fitted with corundum wheels made by the Hampden Corundum Wheel Company, of Springfield, Mass., for trueing up car wheels which show flat spots after service. The wheels need not be removed from the car.

JOHN T. McROY, of Chicago, showed examples of his vitrified terra cotta conduit, the two, three, four and six-duct styles being represented. The samples were well glazed, perfectly smooth on the inside, and appeared well adapted for their purpose. Mr. McRoy had some very interesting letters of testimonial in his pocket, from companies for which he has done work, which reflect great credit on his system.

MR. J. L. BLACK showed a model of his automatic fulcrum hand brake. Mr. Black claims that this brake will stop with a single turn of the handle one of the longest street cars fully loaded in a space of fifty feet. It is very simple in construction and cars can be equipped with this brake at quite a small cost.

K. McLENNAN & CO., of Chicago, were represented by Mr. M. J. Isaacs, who showed samples of their well known Gale's Commutator compound, from the use of which a great saving in the wear of commutator and brushes is guaranteed, absolutely preventing sparking and cutting and not gumming the brushes.

INTERIOR CONDUIT AND INSULATION COMPANY, of New York, were represented by Mr. E. B. Kittle, who had an interesting exhibit of their underground and interior conduits, showing full details of the system. Mr. Kittle had also a parlor on the Southern Hotel, where he showed a few samples of their specialties, and had every means at his disposal for the entertainment of his friends.

THE HYATT ROLLER BEARING COMPANY, of Newark, N. J., and New York, showed a few samples of their flexible roller bearings as applied to car boxes, shafting hangers and pillow blocks. They also had a set of their flexible bearings on one of the trucks of the General Electric Company's exhibit. The company was represented by Mr. F. V. M. Hudson, of New York.

THE NATIONAL WATER TUBE BOILER COMPANY showed a very handsome model of a boiler complete, with brickwork , made to scale, with side removed, to show interior construction. They also showed a full size header, a model of a Standard rocking grate bar, and other special features of their boiler. They were represented by Mr. Frank H. Pond, manager of the St. Louis office.

THE COLUMBIA MACHINE WORKS, of Brooklyn, N. Y., were represented by Mr. J. G. Buehler, of Brooklyn, who showed samples of their drop forged bars for commutators, self-oiling trolley wheels, patent adjustable controller handle, reversible and interchangeable armature bearings and car trimmings of all descriptions. Repairs and rewinding of armatures are a specialty of this company.

THE ST. LOUIS CAR WHEEL COMPANY had a handsome exhibit of all classes of street car wheels, hammered steel and iron axles, of all the standard sizes for street railway purposes. They also showed a large collection of specimens of charcoal car wheel irons, attesting the different depth of chill. They were represented by Mr. R. W. Green, secretary of the company, and Mr. J. W. Nute, general agent.

THE MUNSON ELECTRIC CONDUIT COMPANY were represented by Mr. John H. Munson and William F. Roberts, who had a working model of their system on exhibition, which attracted great attention. They had a section of track about thirty feet long, including a sharp curve, on which they had a model car equipped with their device and operated electrically. This system has many points of advantage, the motor car being always in contact, and the contact points being only alive immediately under the car.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, of St. Louis, had a most complete exhibit of electrical supplies, and represented at the convention hall the following companies: The Bryant Electric Company, lighting supplies; Clifton Manufacturing Company, friction tape; Electrical Engineering and Supply Company, street railway supplies; Holmes, Booth & Hayden, weatherproof wire; Hugo Reisinger, "Electra" carbons; India Rubber and Gutta Percha Insulating Company, Habirshaw Wires and cables; Perkins Electric Switch Manufacturing Company, switches and lamps; Pass & Seymour, porcelains; W. T. C. MacAllen, street railway material; Standard Paint Company, P. & B. paint; Western Electric Company, railway material; Wagner Electric Manufacturing Company, switches, and the St. Louis Car Heater Company, electric heaters, and A. O. Schoonmaker, mica. The company were represented by Messrs. P. D. Cable, V. E. Raggio, and J. B. O'Brien. The company had a magnificent exhibit of all kinds of electrical supplies and specialties, the exhibit being arranged with great taste. At the head was a large board covered with Pass & Seymour porcelains, while all around was a profusion of switches, railroad apparatus, instruments, wire, converters, insulators and everything necessary for the equipment of an electric plant, either for lighting, railway or power purposes. An interesting sample of cable shown was a piece cut from the cable supplied to the Niagara Falls Company, of Habirshaw manufacture, the cable being 3,769,000 circular mils, and insulated with white core.

HOLMES, BOOTH & HAYDENS were represented by Mr. J. O. Crane.

THE CAMPBELL & ZELL BOILER COMPANY were represented by Mr. J. Vernon Campbell.

MR. T. H. DICKINSON was present in the interests of the New York Packing and Belting Company.

DUSENBURY & BOND, of New York, exhibited a full line of carriage trimmings suitable for electric cars.

THE TRIUMPH ELECTRIC COMPANY were represented by Mr. J. C. Hobart, of their Cincinnati office.

THE AKRON INSULATION AND MARBLE COMPANY had a representative in the person of Mr. A. L. Daniels.

THE TAUNTON LOCOMOTIVE MANUFACTURING CO., whose snow plows are so well known, were represented by Mr. R. L. McDuffie.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, had a choice exhibit of their trucks, etc., and a large snow-sweeper outside the building.

THE MORRELL ELECTRIC WORKS, of St. Louis, showed a few commutators, which they make a specialty of supplying to electric railways.

BILLINGS & SPENCER, of Hartford, were represented by Mr. W. B. Post, who showed samples of their well known drop forged commutator bars.

THE BRUSSELS TAPESTRY COMPANY, Chauncey, N. J., showed some beautiful samples of their textile fabrics, suitable for street car windows and curtain fixtures.

MR. LUTHER STIERINGER was one of the prominent electrical engineers present, to make note of the drift of events and throw his influence on the side of good work.

THE AMERICAN ELECTRIC HEATING CORPORATION, of Boston, touch a side of the industry of deep interest to the street railway man, and hence Mr. T. P. Luther found little leisure as their mouthpiece.

THE PERU ELECTRIC MANUFACTURING COMPANY were on the ground in the person of Mr. R. H. Bouslog, who had many friends and customers to see in regard to inquiries for their excellent specialties.

THE SHULTZ BELTING COMPANY had a neat little exhibit of their belting in the gallery, and were represented by Capt. Shultz and the Messrs. Alvord. They still believe in leather, even for the electrical industries.

THE STEEL RAIL part of the business was very adequately represented in the displays of the Johnson Company and the Pennnsylvania Steel Company. There were a number of joint, frog and switch exhibits of the usual character.

THE SAFETY INSULATED WIRE AND CABLE COMPANY were represented by Mr. E. D. Draffen, who had some striking data as to the enormous quantities of "Safety" cable that have been used in street railway construction.

THE WASHBURN & MOEN MANUFACTURING COMPANY, of Worcester, Mass., were represented by Mr. C. H. May, who showed some attractive samples of lead-covered cables, figure 8 trolley wire, a full line of rubber covered wires, submarine cables, magnet wire, lamp cord, weather proof wires, trolley springs, car springs and the Chicago rail bond.

E. T. BURROWES COMPANY, of Portland, Me., showed some handsome models on which were displayed samples of their automatic curtains for both open and closed street cars. They also showed a full line of curtain materials and curtain fixtures, including the water-proof material, Oakette, in twenty different patterns. Mr. H. H. Russell, of Portland, represented the company.

THE PARTRIDGE CARBON COMPANY, of Sandusky, Ohio, had an attractive booth decorated with a handsome framework, displaying large engravings of their well known Partridge self-lubricating motor brush. Mr. J. S. Speers, secretary of the company, was in attendance, and showed to all interested samples of their product varying in size from the smallest fan motor brush to the largest generator brush.

STANDARD PAINT COMPANY, of New York, were represented by Mr. J. C. Shainwald, of Chicago, their Western manager; Mr. C. D. Jones, also of the Chicago office, and R. J. Redick, of St. Louis. Mr. Shainwald and his exhibit with that of the Commercial Electric Supply Company, of St. Louis, had the usual amount of literature, and was calling attention to the new P. & B. motor cloth manufactured by this company.

BOWERS BROTHERS, of Chicago, had an interesting exhibit of solid sheet mica rings, segments, washers, different grades of uncut India and amber mica, used by the electrical trade for insulation. An unusually large sheet was shown that would be difficult to duplicate, being one of the largest in the United States, and a very interesting exhibit was a sheet of mica mined in 1832, being part of the first mica got out in this country. The exhibit was in charge of Mr. E. S. Bowers, of Chicago.

THE M. M. BUCK MANUFACTURING COMPANY, of St. Louis, had a large and interesting exhibit of railway supplies of every description. This company are agents for Charles A. Schieren & Company's belts; rainbow rubber belting, manufactured by the Peerless Rubber Company, of New York; the Shaw patent shaft coupling, manufactured by Patterson, Gottfried & Hunter, of New York, and a number of other valuable specialties too numerous to mention, but which are all necessary to the street railway engineer.

H. W. JOHNS MANUFACTURING COMPANY, of New York, were represented by Mr. E. B. Hatch, of Hartford, Mr. J. E. Meek, of New York, and Mr. McLennan, of St. Louis. They made an exhibit of their electric car heaters in various designs, suitable for either side or cross-seats, and also some of their latest novelties in trolley line devices, among which special attention was called to their new mechanical clip for 8-shaped trolley wire. It is interesting to note also that the car exhibited by the American Car Company, of St. Louis, was equipped with the H. W. Johns heater, as mentioned elsewhere.

THE CENTRAL UNION BRASS COMPANY, of St. Louis, were represented by T. C. White, of St. Louis. They showed a sample board handsomely equipped with street car trimmings, bearings, gear and pinion wheels, brake handles and other specialties. This company also showed samples of the manufactures of the Washburn & Moen Manufacturing Company, mica specialties, of Bowens Brothers, of Chicago; commutator bars from Billings & Spencer, of Hartford, and carbons of the Solar Carbon Company, of Pittsburg. They also represent A. Groetzinger & Sons, of Allegheny City, and showed samples of their rawhide pinions and blanks.

THE HEINE SAFETY BOILER COMPANY, of St. Louis, showed a full size 50 h. p. Heine safety boiler, without any brickwork, so as to exhibit the interior construction, the shell, water legs and tubes being finished in bronze and presenting a very attractive appearance. They also showed a model of a 250 h. p. boiler, one-sixth the actual size, finished complete with mountings, front and brickwork, the heads being made so that they can be readily removed for interior inspection. A water leg of a 200 h. p. boiler was also exhibited, which was taken from the regular shop stock, showing the general excellence of their construction and workmanship. The company was represented by Mr. S. D. Merton, secretary of the company, Mr. Russell Walker, the Cincinnati agent, and Mr. H. C. Meinholtz, superintendent.

MR. HAROLD P. BROWN, of New York, attended the convention and was assisted in showing his extremely interesting exhibit of plastic bonds by Mr. J. S. Tritle, of St. Louis. They showed a case in which were a number of bonds which exemplified in a striking manner the way not to bond, as based on a large series of experiments by Mr. Brown. The plastic bond was also shown as applied to different types of rail. The whole exhibit attracted wide attention, as the plastic bond is so entirely different from any other bond manufactured. It is claimed that with this bond a 90-pound rail will cause a drop of but 0.0045 volts, with 1,000 amperes, remaining perfectly cold. Mr. Brown has a vast amount of interesting information on the subject of bonding, and on tests for drop of potential in all existing methods of bonding rails.

EUGENE MUNSELL & CO.—The exhibit of Eugene Munsell & Co., miners and importers of mica, New York and Chicago, consisted of India and amber mica in a variety of forms. Large, clear sheets untrimmed, as they get in direct from the mines, mica segments, for all the standard railway motors, mica washers, carefully selected India and amber mica cut to size for electrical insulation, rheostat mica, etc., etc. The exhibit of drop forge commutator segments, for which the company are general selling agents, attracted considerable attention on account of the excellent quality of drop forgings exhibited. The blotters, which were distributed on the writing desks in all of the hotels, and at the places of registration in the convention hall, did effective work, as they conveyed to the visiting delegates the fact that the exhibit was one of special interest, and that the mica was received direct from the mines by the burro, or mule, having several large packages strapped on his back. The little mica souvenir which was given away, was well received, and no doubt will be taken home by a large number of the visiting delegates. Many were seen wearing them in the lapel of their coats. The exhibit was displayed in connection with that of the Mica Insulator Company, and the company were represented by Mr. Henry C. Onick, of the Chicago house. The firm's representative in St. Louis is Mr. Arthur S. Partridge, well known to the railway fraternity.

THE CHAPMAN VALVE COMPANY, whose specialty can be seen in so many electrical power plants, had a few of their valves on exhibitions.

BABCOCK & WILCOX boilers were represented by Messrs. Ashburner and Bonner, both well armed with arguments in behalf of that favorite specialty.

THE Q. & C. COMPANY, of Chicago, made an interesting working exhibit of two of their special machines for sawing through rails, an invaluable machine in track construction.

THE CHAPMAN VALVE MANUFACTURING COMPANY showed a complete set of their well-known make of valves suitable for street railway, electric lighting and power stations.

GEORGE P. JONES CO., St. Louis, showed a neat assortment of their oils and greases which are suitable for electric lighting, power and railway work. The exhibit was in charge of Mr. George Higgins.

THE DUFF MANUFACTURING COMPANY, Allegheny, Pa., had a line of their make of the Barrett patent compound lever truck, and oil well jacks. Their automatic liftiang jack No. 2 is used extensively on electric and cable car lines, and is very simple to operate.

MR. W. R. MASON, who has always been a prominent figure at conventions, was to the fore as usual in the interests of the Mason Electric Equipment Company, Chicago; the Fiberite Company, Mechanicville, N. Y., and the Electric Railway Equipment Company, Cincinnati, O.

THE NEW YORK CAR WHEEL WORKS, Buffalo, N. Y., exhibited some sets of their make of wheels for street cars and in the same exhibit were also shown some specimens of the Corning brake shoe, which is manufactured by the Corning Brake Shoe Company, Buffalo, N. Y.

THE NATIONAL LEAD COMPANY, New York, had a very tasteful exhibit which consisted of a complete line of their well-known solder, string solder, and Babbitt metal goods, and they distributed small metal souvenirs. They also had some of their make of white lead and paints. Mr. A. Benzel was in charge.

THE MURPHY VARNISH COMPANY displayed a full line of their well-known brands of varnishes, and had also several specimens of copal, amongst them being one monster piece of kauri gum copal, which they imported from New Zealand, its weight amounting to 100 lbs. This is supposed to be the largest piece of copal in the country.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Iowa, was represented by Mr. J. V. E. Titus, and although this concern did not have any exhibit of its own, their latest and most improved types of lightning arresters were placed in such a very conspicuous position in the fine booth of the Central Electric Company, who are their agents, that they could not fail to attract the attention of the callers to the exhibit.

THE FOREST CITY ELECTRIC COMPANY, of Cleveland, were represented by Mr. W. B. Cleveland, of Cleveland, and Mr. John C. Dalph, of New York. They had a handsome board, on which were mounted samples of their rolled drop and drop forged commutator bars, and also exhibited a sample rail joint, showing the Protective rail bond in place under the fish plate, and also a bond welder, illustrating the method of applying the bond.

THE BETHLEHEM IRON COMPANY, South Bethlehem, Pa., H. F. J. Porter and W. R. Colcord, agents, exhibited a superb hollow forged steel shaft, made of fluid compressed steel, intended for a direct coupled engine now being built for the Northwestern Elevated Railroad of Chicago, by E. P. Allis & Co., of Milwaukee. It is one of twelve now being supplied to different railway systems in Chicago, and would appear to have a large future in the lighting field as well.

THE GOLD STREET CAR HEATING COMPANY, New York and Chicago, showed one of their hot-water circulating heaters for street cars. This heater consists of a stove placed under the car, the smoke pipe passing out at the roof. The stove contains a pipe coil to which is connected a system of pipes running up into the car and around under the seats, by which means the heat is distributed to all parts of the car. The Gold Company also exhibited their several styles of electric heaters for cars, offices, dwellings, steamboats, etc. Mr. C. H. Gold, of the Chicago office, was in charge of the exhibit.

THE STANDARD UNDERGROUND CABLE COMPANY were represented by their Western manager, Mr. J. R. Wiley and Mr. F. C. Cosby, superintendent of construction, exhibited their usual line of handsome samples of lead-covered feeder wires, and cables, and weather proof wires, suitable for street railway and power work. A large reel of weather-proof feeder cable attracted attention as well as a unique souvenir, entitled "A reminder of Ohm's law." The Standard Company is arranging to open an office in St. Louis, in the Security Building, immediately, with Mr. F. C. Cosby in charge, so as to be located on the ground when underground matters shall have been settled, and will no doubt secure their proportion of the business to be done in the near future. Mr. J. R. Wiley has a large acquaintance amongst the wire-using companies in St. Louis, having formerly resided in that city.

THE PHŒNIX CARBON MANUFACTURING COMPANY, of St. Louis, had an attractive exhibit, presided over by Colonel S. G. Booker and Mr. H. I. Page, in which they displayed samples of their celebrated carbon specialties. They gave away a large number of carbon souvenirs, made of motor brush material, which illustrated in a marked degree the fine finish attainable by the methods used by this company, and they also gave away a special souvenir in the shape of a glass paper weight, with a picture of the Phœnix carbon on the back. They are at present making a specialty of motor and generator brushes, and had a huge illustration suspended over their exhibit of the Phœnix self-lubricating brush. They report business in their line exceptionally good, being now weeks behind in their orders. This company also make a specialty of all forms of battery carbons, and, in fact, of every kind of carbon used in the electrical business.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., had an exhibit of their Columbia rail bond. This bond consists of three parts, two copper thimbles, and the connecting copper rod. On each end of the copper rod is a truncated cone head with a fillet at the base. The inside of the thimble is tapered to fit the head of the band, while the outside is slightly tapered in the opposite way. In applying the bond the cone-shaped heads are placed in the holes of the rail from one side, and the thimbles are slipped over them from the other. A portable hand press is then applied and the wedge-shaped head of the bond is forced into the thimble so that it is not possible to see the line separating the thimble and the head in a cross-section of the two. The end of the head of the bond is expanded by a center punch held in position in the press. The press is capable of giving a pressure of from 15 to 20 tons, and when the band is fixed in its place it practically becomes an integral part of the rail, so that it is impossible to twist the bond in the rail. This company claims that it makes the most perfect connection of any bond on the market. Mr. George C. Bailey and Mr. A. B. Conover, Jr., of the Chicago office, and Mr. W. M. Doyle, of Trenton, were around looking after the interests of their company. Mr. Shippy gave general supervision to all the company's large interests.

AN OCEAN CABLE MEMORIAL.

The International Submarine Telegraph Company has decided to initiate a submarine telegraph company memorial throughout the civilized world to honor Cyrus W. Field, who first conceived the ocean cable; Sir John Pender, who risked his capital, and Sir James Anderson, who captained the Great Eastern.

Lord Selborne announced that the scheme has the sanction and encouragement of the Queen.

The memorial will be a scholarship and a home for engineers. A great many well known Americans and Englishmen have lent their names to the plan.

OBITUARY.

H. E. COLLINS.

MR. H. E. COLLINS, senior member of the firm of H. E. Collins & Company, Pittsburg, died on October 14, at his late residence in the East End, Pittsburg. Mr. Collins was a native of New York State, but went to St. Louis at an early age to enter upon a general mercantile career. On the breaking out of the civil war Mr. Collins actively engaged in support of the Union cause, and remained at the front throughout the entire struggle, returning to St. Louis after the close of the war to become an adjuster of insurance losses. This occupation absorbed his entire attention for several years, when he became interested in various iron and steel enterprises in the vicinity of St. Louis, which gradually absorbed his attention to such an extent that he was obliged to abandon all other lines of business.

Having formed desirable connections in Pittsburg he removed to the latter city in 1876, where he founded the firm of H. E. Collins & Company, whose business was that of mer-

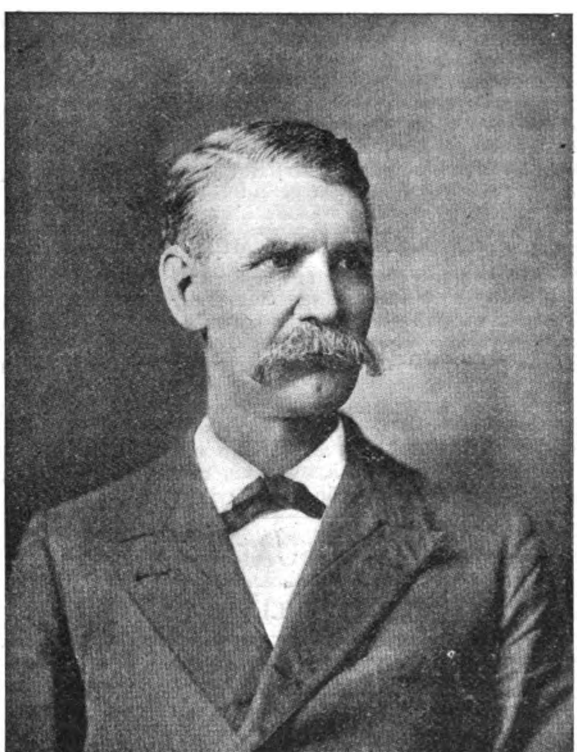
chandise brokers and factors and dealers in ores and metals of all kinds. Mr. Collins remained constantly engaged in this line of business until the summer of 1895, when he associated Mr. W. C. Temple with himself under the same firm name of H. E. Collins & Company, and took up the general introduction of the Cahall boilers. At the time of Mr. Collins' death this business had grown into one of great magnitude, the firm having branch offices in Boston, Philadelphia, New York, Detroit, Cleveland, Chicago, Cincinnati and New Orleans. The business will continue without any changes on the same lines followed in the past.

Mr. Collins was a prominent citizen of Pittsburg, being a trustee of the Homeopathic Hospital, trustee of the Shady Side Academy, an active worker in the matter of education, especially for the very young, and was always foremost in all beneficent or charitable enterprises organized in his city. Mr. Collins leaves a widow and five sons, the eldest being at present in Europe perfecting his musical education; the second son, Henry, is a student at the Naval Academy at Annapolis; the other three sons are living at home.

PERSONAL.

PRESIDENT ROBERT McCULLOCH,

THE new and highly esteemed president of the American Street Railway Association is of Scotch lineage, his ancestors having settled in Virginia in Colonial days, the paternal side in Amherst County and the maternal in Roanoke. The male members on both sides were soldiers of the Revolution. He is native of Rockbridge County, Va., and was educated at the Virginia Military Institute, at Lexington. He went as a cadet in the Confederate service, in April, 1861, and followed General Lee until his surrender in April, 1865. He established himself in St. Louis in 1869, and in 1871 entered the employ of the Bellefontaine Railway Company of that city



ROBERT McCULLOCH.

as superintendent, was afterward made secretary, and then vice-president and general manager of the company. He continued in that service until 1889, when Mr. D. G. Hamilton and his friends purchased the Citizens', St. Louis, Cass Avenue, Northern Central and Union lines, and he was made vice-president and general manager of these roads, which position he now occupies. At the age of twenty-six he married Miss Paxton, of Rockbridge County, Va., and his family consists of his wife, two daughters and a son, Richard McCulloch, who is the civil and electrical engineer of the roads named. His elder daughter, Roberta, is a student at Vassar College, and his Younger daughter, Grace, is receiving education in the public schools of St. Louis.

MR. WILLIAM H. CULL, superintendent of the Hudson River Telephone Company, who was compelled by reason of illness to temporarily leave Albany for treatment, has returned home. His host of friends will be pleased to learn that there is every prospect of his being speedily restored to perfect health.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

On the evening of October 23, at Columbia College, the incoming president, Dr. Charles E. Emery, gave his inaugural address, entitled "Reminiscences of Forty Years of Engineering Experience."

He started out with a statement of the instruction received from a small toy engine when a boy, in which all the complicated movements of a link motion were derived by combining the motions of two cranks at right angles, thus developing at that time what has since been known as the Waelshart gear, used on the Continent and some steam vessels. He told of the efforts of Corliss and Wheelock to overcome the supposed inefficiency of the link motion by the use of special cut-off gear, which proved to be failures, as the link gives the early exhaust and cushioning required for the proper operation of a locomotive. He told of some experience with engines on naval steamers, of which the valve gear was designed by the late Lawyer Dickerson to secure unusual economies, which proved to be failures, referring to the dock trial which took place during the war and proved the old system best. He gave a statement of his early experiments with glass and iron cylinders, showing the loss due to cylinder condensation; discussed the advantages of compound and triple compound engines, and pointed out that it has of late been developed that the number of cylinders has been unwarrantedly increased in many cases, and that for pressures not exceeding 125 pounds fully as economical results can be obtained with a compound engine as with a triple compound engine.

Dr. Emery then gave some war reminiscences, calling attention to the fact that the vessels of the Mississippi squadron were painted with a pigment of river mud so as to be inconspicuous at night or in hazy weather; spoke of Porter concealing the topmasts of his bomb boats with green boughs to resemble the adjoining woods while bombarding the forts below New Orleans. He spoke of his connection with the accepted standard of boiler horse-power; of interesting experiences as judge of the Centennial Exhibition, including his being invited to act as assistant to Lord Kelvin, then Sir William Thomson, but which proved of little service to him on account of extra work caused by disorganization of his own group. He referred to some unwilling work done in superintending early elevators; gave a brief summary of interesting details of the work of the New York Steam Company, including expansion joints, meters, etc. He explained that the work was so exacting that he was obliged to relieve his mind during the evening in a different line, when he occupied himself in discovering the secrets of adjusting watches for position, the principles of which he briefly explained.

Dr. Emery then spoke of his connection with the improvements in terminal facilities of the New York and Brooklyn Bridge and of the valuable assistance that would be rendered by electric locomotives, but stated that contrary to his advice the best plans had not been adopted, in his opinion, for that particular location on account of local weakness of the bridge and the want of adhesion which would be experienced by the use of motors on a single car which should be sufficient to draw four cars on a 3 per cent. grade in sleety weather. He then stated some of the interesting problems he had investigated as an expert in matters relating to water supply, damage by floods, the financial problems arising from questions of replacing water power by steam power forever or for a long series of years, and closed with a brief reference to his experiments on electrical subjects and some interesting features of the tests of the large engine dynamos at the Chicago Exposition by a committee of judges, of which he was the chairman, and which resulted in the discovery at that time of the losses which have been particularly described recently by Mr. Blathy in various publications. The publication of the results of the Chicago experiments have been so long delayed for want of means by the Bureau of Awards that Dr. Emery stated he has in contemplation making a full abstract of the results for the information of the profession, perhaps in the form of a paper to the American Institute of Electrical Engineers, with-

out, however, referring to the particular exhibitors, and considering all the engines of equal efficiency and with the same friction.

MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The one hundred and ninth meeting of the institute was held on Wednesday evening, October 21, President Duncan in the chair, and one hundred members and guests present.

The meeting was devoted to a topical discussion of "Electric Traction Under Steam Railway Conditions." It was opened by Dr. Charles E. Emery. Communications were read from Charles K. Stearns and Charles H. Davis. The discussion was then taken up by Messrs. H. Ward Leonard, George S. Strong, A. E. Kennelly, C. F. Uebelacker, E. E. Ries, George L. Colgate and F. W. Darlington.

It is the intention to discuss the same subject at the Armour Institute, Chicago, October 28.

At a meeting of the Executive Committee, held in the afternoon, the following Associate Members were elected: Benoliel, Sol D., 1327 Broadway, residence, 120 West Thirty-fifth street, New York City; Fish, Milton L., Assistant Manager, Pasadena Electric Light and Power Company, Pasadena, Cala.; Rice, Arthur L., Professor of Steam and Electrical Engineering, Pratt Institute, Brooklyn, N. Y.

The following Associate Members were transferred to Membership: Herdman, Frank E., Mechanical and Electrical Engineer, Crane Elevator Company, Winnetka, Ill.; Gerry, M. H., Jr., Superintendent of Motive Power, The Metropolitan West Side Elevated Railroad Company, Chicago, Ill.; Hadaway, W. S., Jr., Electrical Heating Engineer, 107 Liberty street, New York City.

AMENDMENTS TO THE NATIONAL UNDERWRITERS' RULES.

Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, has just issued a notice announcing the annual meeting of the Electrical Committee of the association on December 8. The committee will be glad to receive suggestions regarding changes in or additions to the present rules, which those interested in the subject may wish to make. Blank forms will be furnished on application upon which the suggested changes can be drawn up, which will be submitted at the committee meeting. These blanks can be had by addressing the secretary of the association, at 55 Kilby street, Boston, and they should be filed not later than December 1.

NORTHERN ELECTRICAL ASSOCIATION.

The fifth annual convention of this association will be held in Milwaukee, commencing on January 20, to which all interested in electrical work are invited.

The secretary of the association has issued a blank circular of information containing a large number of questions, addressed to all electric lighting companies in the country. These, when returned, will be kept on file at the office of the association for the use of members.

ELECTRIC LIGHT MANAGERS IN OHIO.

The Ohio State Convention of Electric Light Managers has elected the following officers: President, John I. Beggs, of Cincinnati; vice-president, G. S. Long, of Troy; secretary-treasurer, Samuel Scovil, of Cleveland. The next annual meeting will be held in Cincinnati.

TELEGRAPH CELEBRATION IN BELGIUM.

The Belgian Administration of Posts and Telegraphs has been holding a celebration in Brussels, in honor of the jubilee of the telegraph service. There were many interesting features. A large picture was exhibited in the central hall of the Telegraph and Posts building, representing S. F. B. Morse, with a paper tape in his hand containing the famous first message: "What hath God wrought," and resting his hand on a telegraphic globe.

THE DESIGN OF LARGE ARC DYNAMOS.

REFERRING to the description of the design of large arc and composite dynamos by Mr. George Albers in our issue of Oct. 7, Prof. Elihu Thomson has favored us with the following comments:

"The article on the design of large arc dynamos by Mr. Albers deals with a question to which I have given considerable thought.

"Mr. Albers proposes to revolve brushes in contact with incomplete rings in his arrangement. I should not think this was as good as revolving the segments and leaving the brushes stationary, where they can be attended to or adjusted if necessary. The machine which he proposes I should think would, also, in case any little trouble happened to the commutating arrangements, have to be shut down, and precisely the same purpose, I think, could be fulfilled by changing the arrangement so as to keep the brushes stationary and revolving the contact segments, as in almost all apparatus of this kind these two things are interchangeable in their relations.

"I have not had time to study into the merits or demerits of the machine in detail, but I will simply say that I agree with Mr. Albers in the general idea that a large machine having several circuits is desirable, and that a machine with stationary armature coils gives, as I pointed out in my patent, the ability to regulate in a variety of ways. In fact, Mr. Albers speaks of these ways in connection with the type of machine which he proposes. He speaks of the use of choke coils or constant current transformers. These are the precise devices which I have shown in my patent as applicable to the case in question. I do not think that the regulation for arc light loads could be effected by putting opposite sides of the dynamo in parallel through a commutator, as that would change the character of the machine. Perhaps Mr. Albers does not mean that this shall apply to arc light work.

"The question of combining in one large generator, directly connected to the engine, a number of separate dynamos, which may be used for arc lighting or for other work, was presented to my mind many years ago, and I worked out the type which is described in my patent No. 538,406, as one which met most completely the practical conditions, inasmuch as the commutators might be replaced even while the machine is running, and indeed sections of the machine itself removed for repairs without disturbing the working of the other parts."

LETTERS TO THE EDITOR.

ELECTRIC RAILWAY PROBLEMS.

Your editorial in the current issue on "Electric Railway Problems" states many facts which are universally conceded by unprejudiced engineers. Your belief "that a one-motor equipment can be produced that will do all and more than the present two-motor arrangement" bids fair to be soon realized. I am at present constructing a horseless carriage on the plans of my hydraulic system of street car gearing which has already been described in the Engineer, and present indications are that it will fully demonstrate the practicability of such a system, and such being the case it will readily be seen that it will fulfill all the requirements you mention, besides many others, the most important perhaps being the possibility of using the single phase alternating motor. HARRY E. DEY.

Pawtucket, R. I.

LEGAL NOTES.

GENERAL ELECTRIC vs. A SIEMENS-HALSKE PURCHASER, SETTLED OUT OF COURT.

In the United States Circuit Court at St. Louis on October 20 the complaints of the Edison Electric Light Company and the Thomson-Houston Electric Light Company against the Union Terminal Association were dismissed, the parties litigant having settled the matters in controversy outside of court, upon terms mutually satisfactory.

The suit is based upon the fact that about three years ago the Union Terminal Association purchased from the Siemens & Halske Electric Company an electric light plant for use in the Union Station in St. Louis. As soon as the plant was in successful operation the Edison Company and the Thomson-Houston Company brought suit against the Union Terminal Association alleging that the plant in use by the latter embodied various infringements of patents owned by the plaintiffs.

The settlement will not involve any expense to the Union Terminal Association, inasmuch as the manufacturers from whom the plant was purchased stand ready to make good any legal damages incurred by the use of their machinery.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 13, 1896.

Alarms and Signals:—

SPEED INDICATING ALARM. Benj. F. Card, Brooklyn, N. Y., 569,171. Filed Aug. 31, 1895.
Means governed by the trolley independently of electrical energy for giving a signal at a predetermined speed of the car.

COIN-CONTROLLED SIGNAL APPARATUS. William Gray, Hartford, Conn., 569,195. Filed Sept. 7, 1895.
Details of construction.

BLOCK SIGNAL. L. C. Smith, Carbondale, Pa., 569,246. Filed July 9, 1895.
Comprises a series of locking devices operated simultaneously to lock the signal in the "danger" position upon the passage of a train, and means for unlocking the devices successively.

RAILWAY SIGNAL. J. Wayland, Newark, N. J., 569,263. Filed April 14, 1896.
Employs electromagnets operated by the passing of a train.

RAILWAY SIGNAL. James Wayland, Newark, N. J., 569,264. Filed April 14, 1896.
Consists of a supporting frame secured to the post, a semaphore rotatably mounted thereon, and a web on the frame overhanging the joint between the fixed and movable parts of the signal.

RAILWAY SIGNAL. J. Wayland, Newark, N. J., 569,265. Filed June 2, 1896.
Similar to above.

ELECTRIC TROLLEY RAILWAY SIGNAL. H. A. Parrish, Jackson, Mich., 569,424. Filed Oct. 23, 1895.
Means whereby the trolley wheels of the cars operate the circuit terminals to make and break the relay circuit to start and stop the signal.

BLOCK SIGNAL SYSTEM. J. E. Donbavand, Millville, N. J., 569,551. Filed Nov. 23, 1894.
The combination with a signal post, of the semaphore arm having a knife edge bearing thereon, a toothed segment connected with the arm to swing it to "danger," and operating mechanism geared to the segments.

Batteries, Primary:—

METHOD AND MEANS FOR ELECTRIC GENERATION. S. H. Short, Cleveland, O., 569,591. Filed April 9, 1896.
Consists in subjecting carbon to the electrochemical action of an electrolyte, capable of acting upon the carbon and regenerating the electrolyte through the agency of the negative plate.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. G. T. Woods, New York, 569,443. Filed Feb. 5, 1896.
Places in the circuit between the constant potential generator and the translating device a separately excited variable potential generator.

Dynamos and Motors:—

MAGNETO ELECTRIC GENERATOR. C. H. North, Cleveland, O., 569,385. Filed April 14, 1896.
Details of construction.

Electro-Metallurgy:

APPARATUS FOR MELTING METALS. E. G. G. Moldenke, Pittsburg, Pa., 569,221. Filed May 18, 1896.
Comprises a crucible furnace with sloping platform carbon electrodes inserted through the walls and a horseshoe magnet set between the electrode to blow the arc toward the charge.

Lamps and Appurtenances:—

SHADE HOLDER FOR INCANDESCENT LAMP SOCKETS. M. D. Greengard, St. Louis, Mo., 569,556. Filed Jan. 20, 1896.
Comprises a ring provided with circumferentially extended spring clasps and slides movable independently of them whereby they may move along both ring and clasp to operate the latter.

Miscellaneous:—

APPARATUS FOR DISINFECTING SHIPS OR OTHER STRUCTURES. H. R. Cassel, New York. 569,173. Filed June 29, 1894.
Consists in electrically producing a disinfecting fluid and a system of piping for distributing it in different parts of the ship.

ELECTROMAGNET. J. Wayland, Newark, N. J., 569,262. Filed Dec. 10, 1895.
Embodies an armature provided with wings to pass over two side polar faces, and a mass of iron connecting the wings to co-operate with the end polar face.

ELECTRIC HEATER. G. B. Fraley, Philadelphia, Pa., 569,278. Filed July 11, 1896.
Embodies a fireproof cylinder, coils of wire wound around the cylinder and a perforated metallic casing inclosing the same.

TIMING MECHANISM FOR RACES. C. A. Newbaker, Pittsburg, Pa., 569,296. Filed Feb. 25, 1896.
An electrically controlled clock mechanism adapted to be set in operation on the passage of the first horse across a predetermined line and to be stopped on the completion of the race.

PROCESS OF AND APPARATUS FOR PRODUCING CYANIDS. P. Danckwardt, New York, 569,325. Filed July 1, 1896.
Consists of melting the chlorid, introducing into the molten bath carbon and nitrogen, electrolyzing the bath while in contact with carbon and nitrogen, and continuously removing the cyanid so formed from the action of the electric current.

DENTAL CATAPHORIC APPARATUS. M. W. Hollingsworth, Philadelphia, Pa., 569,380. Filed June 29, 1896.
Comprises a yielding carrier adapted to be self-conforming to the surface with which contact is to be made. Intended for treatment of the teeth.

ELECTROTHERAPEUTIC BAND. B. H. Vellines, Norfolk, Va., 569,529. Filed Nov. 30, 1895.

Railways and Appliances:—

ELECTRIC BOND. M. J. Wightman, Scranton, Pa., 569,266. Filed Feb. 20, 1896.
Consists of a continuous plate of metal having upturned lips for union with the edge of a metal flange, and a bent intermediate portion, laid under the rail ends.

ELECTRIC RAILWAY. A. Gorton, Philadelphia, Pa., 569,331. Filed Dec. 31, 1890.
The conductor is placed in a longitudinal recess in the track and the current is taken by means of swinging brushes normally insulated from each other.

TROLLEY WIRE HANGER. W. S. Kisinger, Bantam, O., 569,338. Filed Feb. 8, 1896.
Consists of a yoke, an insulated member applied thereto, and having a vertical chamber with a pair of inclined bearings at its lower end, and a line wire holder provided with a pair of inclined lugs that engage over the bearings.

TROLLEY CATCHER. C. F. Randall, Denver, Colo., 569,352. Filed Feb. 11, 1895.
Comprises a casing, a two-part weight located therein, a spring held rod connecting the two parts of the weight, a dog hinged to the rod, a rachet located in suitable proximity to the weight, and a connection between the weight and the trolley pole.

ELECTRIC RAILWAY SYSTEM. B. R. Shover, Indianapolis, Ind. and E. P. Townsend, Asbury Park, N. J., 569,432. Filed Sept. 10, 1895.
Sectional conduit system.

Regulation:—

SYSTEM OF CONTROL FOR ELECTRIC MOTORS. E. A. Sperry, Cleveland, O., 569,305. Filed Feb. 21, 1895.
The combination of a main and auxiliary field coils, and means for connecting the auxiliary field coil to the main source of supply.

Switches, Cut-Outs, Etc:—

ELECTRIC SNAP SWITCH. C. G. Perkins, Hartford, Conn., 569,299. Filed July 31, 1896.
Means to permit the cover to be held positively in place by the handle.

ELECTRIC SWITCH. W. H. Powell, Hartford, Conn., 569,300. Filed Feb. 8, 1896.
A single pole switch

ELECTRIC SWITCH. W. H. Powell, Hartford, Conn., 569,301. Filed Feb. 8. 1896.
Similar to above.

ELECTRIC SWITCH. W. H. Powell, Hartford, Conn., 569,302. Filed June 29, 1896.
Comprises a base with a plural number of contact plates and brushes arranged in sets.

ELECTRIC SNAP SWITCH. G. B. Thomas, Hartford, Conn., 569,309. Filed May 16, 1896.
Employs a rotary block to make and break circuit.

SNAP SWITCH. G. W. Hart, Hartford, Conn., 569,332. Filed July 9, 1896.
Details of construction.

CUT-OUT FOR ELECTRIC CIRCUITS. L. W. Downes, Providence, R. I., 569,373. Filed July 23, 1896.
Consists of a fuse wire combined with an insulating sheath, and surrounded by a mass of finely divided refractory material in a loose condition, in such manner as to leave an air space about the fuse wire.

AUTOMATIC CUT-OUT FOR ELECTRICAL TRANSFORMERS. A. C. Booth, Cedar Rapids, Ia., 569,538. Filed Feb. 6, 1895.
Means for automatically cutting out transformers whenever they are not needed.

ELECTRIC SWITCH. G. Emmett, Attleborough, Mass., 569,576. Filed Feb. 26, 1896.
Especially adapted for cutting out arc lamps.

Telephones:—

ADJUSTABLE BRACKET FOR TRANSMITTERS. A. Y. Gordon, Massillon, O., 569,376. Filed July 21, 1896.
Comprises a plate having hinged thereto a bar provided with discs, heads pivotally connected to the bar, parallel bars connected to heads at the inner and outer ends, and the bar carrying the transmitter.

MULTIPLE STATION TELEPHONE CIRCUIT. J. A. Barrett, Rutland, Vt., 569,401. Filed Jan. 27, 1896.
Means for calling the substations selectively.

TELEPHONE EXCHANGE SYSTEM. P. E. Raverot and G. A. Hess, Paris, France, 569,470. Filed July 8, 1896.
Consists in a system of disposing and connecting the different devices constituting the switchboard.

NEWS AND NOTES.

THE STANDARD THERMAL UNIT.[1]

This report, read at recent B. A. meeting, advocates international discussion on the subject of a new thermal unit. It proposes to adopt the erg as the absolute primary standard of heat. As a secondary standard, of sometimes more convenient magnitude, an amount of heat equal to 4.2×10^7 ergs is suggested, and it is proposed to call this secondary unit the "Calory." As a method of defining this secondary unit, it is suggested that it might be specified as being one water-gramme-degree between 9.°5C. and 10.°5C., or, if this range of temperature is not consistent with a value of 42,000,000 ergs, then any other range of temperature of 1°C. as shall in future be determined to give a value of 42,000,000 ergs to the water-gramme-degree. This device has the advantage of fixing the value of the secondary unit independently of thermometry.

ARRESTED FOR SWEARING OVER THE TELEPHONE.

A novel arrest was made at Reading, Pa., on Oct. 13. Edward Hahl, a traveling salesman, called up the Union Transfer Company by telephone, and, it is alleged, used profane language to the lady clerk to hurry up the delivery of his baggage. He was arrested on a warrant, charging swearing, and committed in default of payment of fine.

[1] Abstract from the Report of the British Association Committee on Electrical Standards.

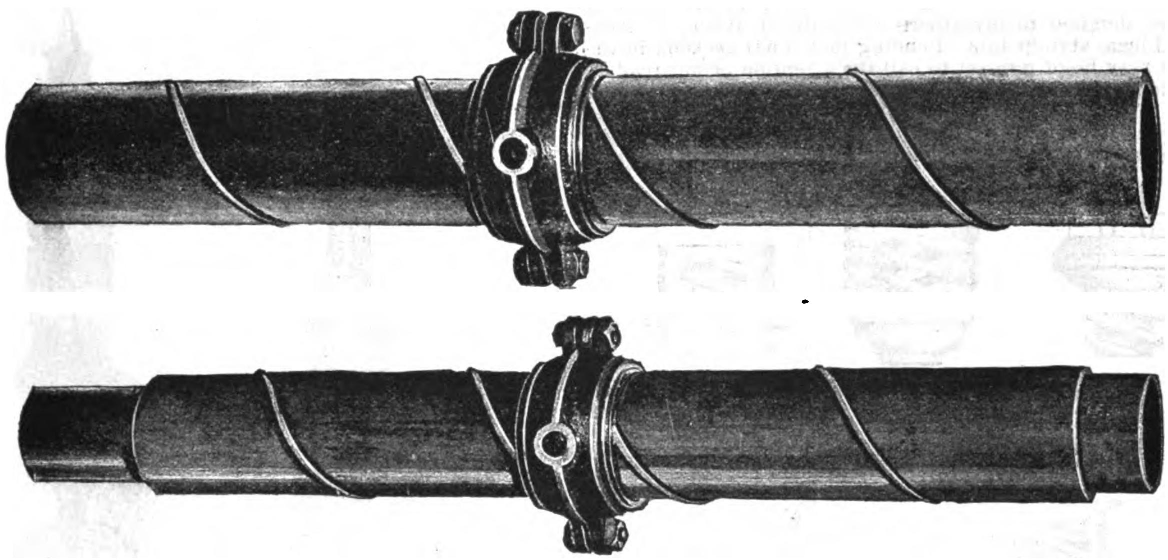
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

INSULATING SUBWAY CONDUITS OF THE INTERIOR CONDUIT AND INSULATION CO.

IN a handsomely printed catalogue just issued by the Interior Conduit and Insulation Company, we find an excellent illustrated description of that company's new system of insulating subway conduits, which presents several features of great novelty and utility.

The company has taken a bold stand by reversing the existing practice of placing main reliance upon the insulation of the wires and cables by so perfectly insulating the conduits themselves that the insulation of the wires becomes secondary and subordinate, such insulation, in fact, being only necessary where more than one wire is placed in a single duct, and then only for the purpose of insulating the wires from each other and not at all for the purpose of insulating them from the earth.



FIGS. 1 AND 2.—TYPES OF TUBING EMPLOYED IN NEW INSULATING SUBWAY CONDUIT.

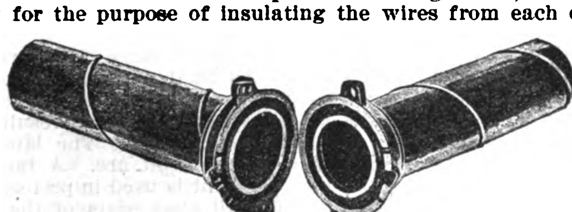


FIG. 3.—JOINT OF INSULATING CONDUIT.

By the use of this system it is claimed that not only are the wires fully preserved and protected, so far as insulation is concerned, but the lead covering now employed is rendered superfluous, the original cost and cost of handling of conductors largely reduced, and the bad effects of electrolysis are removed.

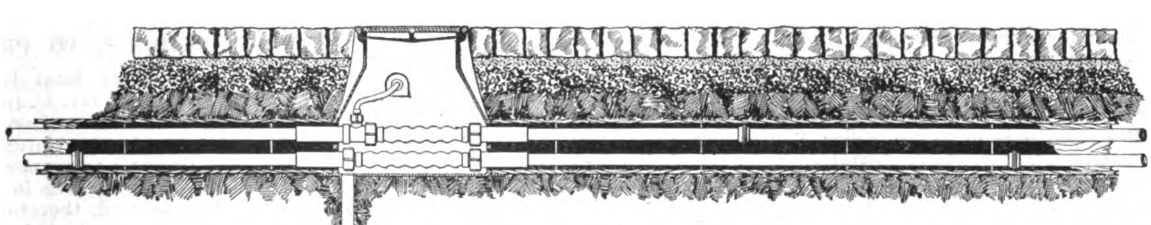


FIG. 4.—NEW INSULATING SUBWAY CONDUIT OF THE INTERIOR CONDUIT AND INSULATION CO.—SECTION.

The company, in fact, take the view that the correct principle is to have the insulation a part of the permanent and fixed equipment, and the copper as free and portable as is consistent with the nature of the work it is employed to do. If a single conductor, as, for instance, a railway feeder, it need have no insulation other than that afforded by its containing duct. If there be a series of conductors, they need but to be insulated each from the other.

In general, the system consists of a continuously insulated duct or raceway protected by heavy sheet iron armor, any number of the tubes thus formed being laid in a wooden trough or trench, and embedded in a plastic insulating compound for the further insulation and protection of the whole. The manholes are provided with especially devised means for continuing both the insulation and the protection across their area, while at the same time affording the convenient and effective access to each conductor, so essential in original installation and to the making of branch connections, as well as the periodic examinations of the conductors, which are so essential in all systems of wiring.

In order to meet the multifarious requirements of the several kinds of electric service, the varying conditions of soil and the diverse opinions of experts and practical men, the company manufacture tubes in a variety of types. Thus they make a simple tube of sheet iron of any desired weight and lined with their standerd asphalt treated insulating paper tubes, Fig. 1. For exceptionally high insulation, as where uninsulated wires are employed, this same tube is employed, but telescoped within it is an additional paper tube, the telescoping being done in such a manner as to prevent the joints or unions of the inner and outer tubes from becoming coincident. This yields, in effect, a continuous tube without joints, Fig. 2.

For feeder wires, or other service lines which are liable to become overheated and perhaps ultimately impair the insulation or imbed themselves in the insulation, so as to render their withdrawal in case of necessity extremely difficult, the company make a tube similar to that shown in Fig. 1, but with the addition of an inner lining of heavily coated sheet iron. In order to prevent the formation of a high static charge, and the consequent possible piercing of the insulation, these interior metal linings are made non-continuous by allowing a slight separation at each joint; this separation, however, is not sufficient to impair the utility of the lining for the purpose for which it is employed, but is ample for the purpose of overcoming electro-static effects.

The tubes are joined at their ends by cup-shaped locking collars having an annular chamber for the insertion of liquid insulating material through several openings. These collars or couplings are secured by locking bolts, as illustrated in Fig. 3.

To afford a simple and efficient means for insulating the conductors at manhole crossings, to effect a ready means for inter-

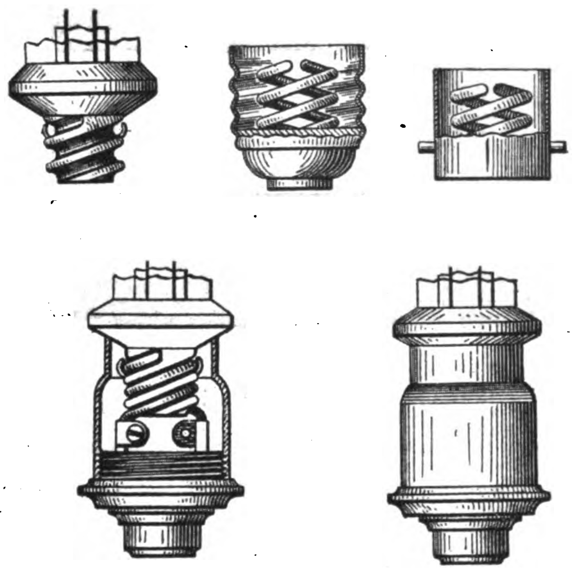
connection, and to give flexibility in the matter of size, construction, etc., for any desired number of ducts, the manhole illustrated in Fig. 4 has been designed for use in connection with their system.

The Interior Conduit and Insulator Company believe that this system presents the maximum advantages of insulation, permanency, convenience of handling, with a minimum of cost, both original and for maintenance.

CRIGGAL'S UNIVERSAL INCANDESCENT LAMP SOCKETS.

THE recent gathering of manufactui e: s and others inte ested in the adoption of a standard incandescent lamp base and socket, called together under the auspices of the National Electrical Light Association, is now awaiting the report of a committee detailed to investigate the subject, from the technical and legal standpoints. Pending their final decision in the matter it may be of interest to call the attention of our readers to a device of this nature, due to Mr. John Criggal, of Newark, N. J.

This consists of a lamp base made of a molded material, much resembling porcelain in its nature, and consisting of a



FIGS. 1 TO 5.—THE CRIGGAL UNIVERSAL INCANDESCENT LAMP SOCKET.

threaded portion, at the upper end of which the leading in wires are embedded, and whose ends protrude in the shape of small hooks, as shown in Fig. 1. Into this base there is screwed a socket, consisting of two spirals, Fig. 2, which represent the Edison lamp base; Fig. 3 shows another type, the Swan base; Figs. 4 and 5 show the base and socket when in position. As will be seen the spirals when screwed home engage the hooks forming the ends of the leading in wires, and thus make the desired contact. It will readily be seen that by this simple device any type of socket can be applied to the lamp base, and at a trifling cost.

THE STOREY MOTORS.

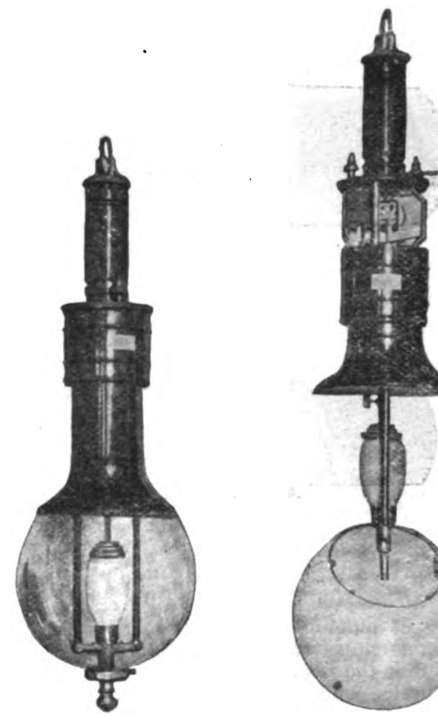
Mr. I. E. Storey, the president of the Storey Motor & Tool Company, Philadelphia, informs us that the concern has moved its main offices to 214-226 Carter street, below Chestnut, where, with greatly increased facilities, made necessary by the rapid growth of their business they will be able to execute promptly orders of any size. Mr. Storey regards the near outlook for his motors, etc., as very bright.

HAMMACHER, SCHLEMMER & CO.'S TOOL CATALOGUE.

The well konwn firm of Hammacher, Schlemmer & Co., 209 Bowery, New York City, have just issued a new and splendidly complete catalogue of their cabinet hardware, tools for all trades, specialties for electrical machinists, and a number of choice and meritorious novelties. Among the innumerable articles listed in this remarkably exhaustive catalogue, of interest to the electrical trade, are locks for telephone boxes, screws, wire nails, brass butts, piano wire of exceptionally high grade and temper, such as is particularly desirable in switch springs; files, saws, hammers, rules, tool chests and sets, vises, taps, screw plates, oilers, wrenches, etc. There is also a wide range of trimmings. The articles are profusely illustrated, scientifically grouped and classified, with prices, sizes, etc. Everything is strictly guaranteed. Firms and operating companies using goods of this class in the various electrical lines will certainly find it to their advantage to write Hammacher, Schlemmer & Co. and get a copy of this useful catalogue, which will be cheerfully sent on application, to any address.

THE "AJAX" ARC LAMP.

A NEW enclosed arc lamp that has already given a very good account of itself is the "Ajax," manufactured by Pomeroy, Woltmann & Co., 43 Cortlandt street, New York, which, it is claimed, will find favor with users of long life lamps. Among the special features of the "Ajax" lamp is the arc enclosing globe, which rests upon an air-tight ground



THE AJAX ENCLOSED ARC LAMP.

joint base, and for its cap has a series of three chambers, each successive one a little smaller and further removed from the arc, thereby greatly impeding the entrance of oxygen into the inner globe and causing a very steady light and resulting in but little combustion at the carbon points. The lamp consumes 4.7 amperes and carries an 80-volt arc. A rack rod, with a simple and positive escapement is used in preference to the clutch mode of feeding, and all steel parts of the movement are nickel plated to prevent rusting.

The outer globe holder is also a very simple and neat device, allowing the globe to swing entirely free from the lamp frame, and on this account and because the arc enclosing globe rests upon a ground joint base, it is claimed to be the easiest lamp on the market to trim.

Then, too, the shape of the inner globe is such that while the neck is large enough to admit of easy cleaning, the conformation insures an even distribution of the rays of light. The "Ajax" lamp is particularly adapted for large interior lighting.

NOT RAINBOW, BUT IRON BRIDGES, TO PROSPERITY.

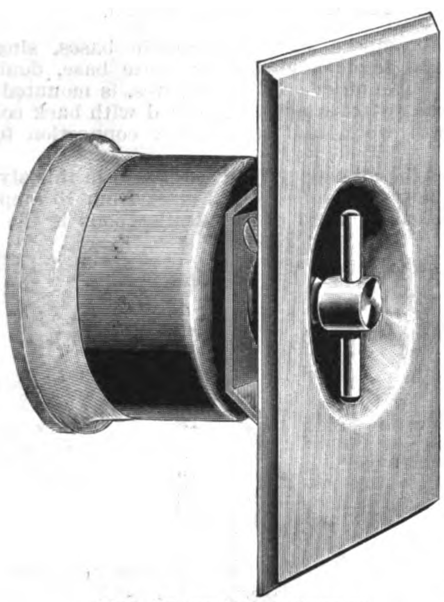
The Berlin Iron Bridge Company, of East Berlin, Conn., have received from their representative, Mr. C. Lerdo, Mexico, the contract for an iron market house at Guadalajara. If this market house were built anywhere in the United States and paid for in our own money, the contract price would be $5,615. The Berlin Company are, however, to receive in payment for this building Mexican silver dollars, and, therefore, their contract price with the city of Guadalajara is $11,230.

If the silver platform should prevail and there should be free coinage of silver on the basis of 16 to 1, what is to prevent the Berlin Iron Bridge Company from taking the dollars which they receive in payment on this building, each one of which contains more silver than the American dollar, take these to the United States mint and, free of expense, have them coined into American silver dollars? Under free silver they will then receive for their building 11,230 Bryan dollars, which, it is

claimed will be worth as much as gold dollars. Consequently they can be used in paying the employés, thus leaving the company a clear profit of over $5,000 on this one little transaction. Or, again, they can take these same 11,230 standard silver dollars and with these pay the labor and expense of building another market house, another bridge or building for the Mexican market, and receive for the same 22,460 Mexican dollars. They can then recoin these free of expense into American dollars, and thus by each transaction double their money. Does any laboring man in this country believe that labor paid for in money of that kind will have the purchasing power of our present dollar? Would there be any difference in paying labor in those dollars and reducing the present rate of wages 50 per cent.?

THE NEW PLATT FLUSH SWITCH.

IN addition to their New England switches, the O. S. Platt Manufacturing Company, Cannon street, Bridgeport, Conn., are now manufacturing what they regard as one of the strongest and best flush switches ever made, the design of Mr. Platt, who has always been so prolific in this field of engineering invention. The cut shows that the switch is self-



New Platt Flush Switch.

contained. Having a strong brass cap, it is not necessary for it to have an iron casing, as is the usual custom with flush switches. It is dustproof, has a swift, sharp snap, and when properly put up, is said to be absolutely without need of further atention. It is made in one size for ten amperes. The concern are also pushing their 500-volt New England switches for street railway use, and expect soon to have one or two other novelties on the market.

ACTIVITY OF THE ENGINEERING FIRM OF BRYAN & HUMPHREY, ST. LOUIS.

The firm of Bryan & Humphrey, consulting mechanical and electrical engineers, Suite H, Turner Building, St. Louis, has found business quite satisfactory during the past few months, in spite of the prevailing depression. It will be recalled that Mr. William H. Bryan, finding his work in mechanical engineering, especially in water-works, boiler and engine trials, steam heating and ventilating, growing to such proportions as to make additional expert assistance necessary, entered into a partnership last spring with Mr. H. H. Humphrey, with a view of having the latter take charge of the work in electrical engineering, and also to relieve Mr. Bryan somewhat in other professional work. That this combination is considered a good one is evident from the demand they are finding these dull times, for their services. They are now engaged upon, or have recently finished, work for the following well known firms:

Boiler and engine work: Laclede Car Company, John O'Brien Boiler Works Company, Herf & Frerichs Chemical Company, St. Louis Sanitary Company, Consumers' Brewing Company, Samuel Bowman & Co., owners, Fraternal Building, all of St. Louis; Edwardsville Electric Light and Power Company, Edwardsville, Ill.; L. Hoster Brewing Company, Columbus, O.

Water-works: City of Union, Mo.; City of Pacific, Mo.

Electrical work: City of Staunton, Ill.; City of Webster Groves, Mo.; A. Leschen & Sons' Rope Company, St. Louis Iron and Machine Works, Ely-Walker Dry Goods Company, Dozier Bakery, all of St. Louis.

Heating and ventilating: The new City Hall, the Y. M. C. A. Building, Missouri Medical College, W. E. Beckman, residence; L. D. Dozier, residence; the Hitchcock Building, all of St. Loius, and J. D. Gerlach, Chester, Ill.

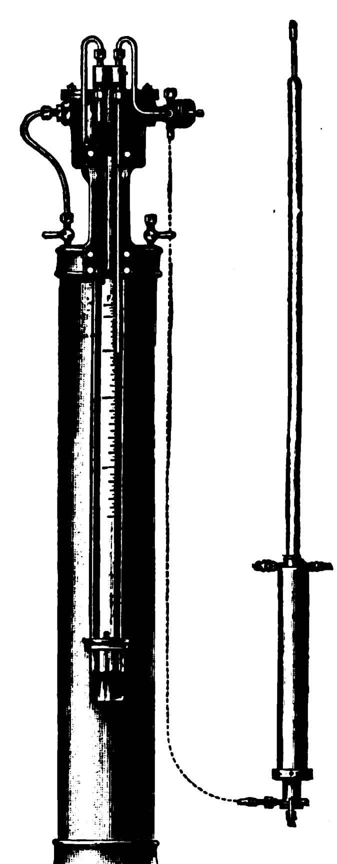
In addition to the above they have handled a great deal of less important work. They also have in hand the preliminary work for some important electric railway projects.

THE PNEUMATIC PYROMETER.

We illustrate in the accompanying engraving a novel form of instrument which is destined to become an important factor in all industrial operations where high heats are employed, and where the quality of the product depends largely upon the manner in which the temperature is applied and regulated.

This pneumatic pyrometer, manufactured by Uehling, Steinbart & Company, Limited, 62 Mulberry street, Newark, N. J., has proved itself accurate and reliable for temperatures up to and exceeding 3,000 degrees, Fahr. It is based upon the expansive properties of air employed in the following very unique but simple manner:

If two minute apertures form, respectively, the inlet and outlet of a chamber, and air be drawn through this chamber by a constant suction, then the tension in the chamber depends upon the difference of temperature of the air as it flows through the respective apertures. Hence if the inlet aperture be located in the space the temperature of which is to be measured and the outlet aperture is maintained at constant temperature, the tension between the two apertures will be a true measure of the temperature at which the air enters the inlet aperture, and consequently of the space in which it is located. This instrument not only indicates the temperature accurately and continuously, but it does it at a distance, and at several places



The Pneumatic Pyrometer.

at the same time if desired, and makes an autographic record of the same. It shows continuously what is happening at the time, and also what has happened within its province at any time previous. This instrument has already found great favor among the manufacturers of iron and steel.

Its use in electrical work is also generally applicable, as, for

example, in the baking of incandescent lamp filaments, electric furnaces, etc. It can also be employed to give a continuous record of the temperature in boiler furnaces, and thus acts as a continuous check on the work of the fireman.

The instrument is substantially and accurately made, and the principle of its construction makes it practically impossible to get out of order.

A BROADSIDE OF SEARCHLIGHTS.

One of the most enthusiastic of the electrical goldbugs is Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, N. J., and he showed his patriotism by making a grand display of searchlights in connection with the Sound Money marine parade of the New York shipping, which took place on the night of Oct. 24. Besides having over a dozen powerful lights on vessels in the parade, there were erected on the roof of the seven-story Rushmore factory, which is opposite Cortlandt street, New York, a solid line of fifteen 40-ampere projectors of the latest type and being on the water front and over 125 feet above the water, they commanded every point in the city and harbor.

These lights were operated by skilled attendants who had been drilled to work them together to produce some beautiful effects and the spectacle as viewed from New York was exceedingly impressive. Power was supplied by a 250 h. p. Corliss engine driving a 110-volt Rushmore generator, which by day furnishes the power for the various departments of the works.

The same apparatus will be used on election night and has been engaged by a New York newspaper to announce the result of the election by flashes on the sky, which will be seen for miles in all directions.

BIDS WANTED FOR ELECTRIC LIGHT PLANT IN THE NEW YORK POST OFFICE.

The Theasury Department, through W. E. Curtis, acting secretary, is inviting proposals until November 9, for installing an electric light and power plant in the Court House and Post Office Building in New York City.

Proposals will be received, first, for wiring building; second, for dynamos and engines; third, for boilers and connections; fourth, for the plant complete; fifth, for the removal and purchase of eight boilers now in the building.

Prospective bidders may obtain additional information and particulars by addressing Hon. W. E. Curtis, acting secretary of the Treasury, Washington. D. C.

STREET LIGHTING WITH INCANDESCENTS IN ST. LOUIS.

Incandescent electric lamps will be used in lighting the streets, alleys and public places in St. Louis under the contract authorized by the ordinance which passed the Municipal Assembly just before the summer recess began. The specifications adopted by the Board of Public Improvements contain a provision to this effect, and say that the lamps shall be of 32 c. p. By the terms of the ordinance the board is directed to solicit bids for lighting that part of the city lying north of Keokuk street for a term of twenty years from January 1, 1900, and the remainder of the city from February 17, 1905, to December 31, 1919, the new contract to begin at the expiration of those now existing. The specifications provide for a single letting of the contract. No day has yet been set for beginning the advertisement for bids. The letting will be held after ninety days' advertising. It is estimated that on January 1, 1900, when the new contract begins, 25,000 lights will be needed in the territory north of Keokuk street. Payment is to be made at a rate to be named for each 1,000 lamp hours.

SUNBEAM INCANDESCENT LAMP CO.

The Sunbeam Incandescent Lamp Company, Chicago, has completed and is now operating its new factory at Desplaines, Ill., just outside of Chicago limits. In every department, new and special apparatus has been added with the view of improving the product. Although the new factory is very much larger than the old one, it has already been found necessary to operate it at its full capacity, so as to keep up with the large number of orders that are being received. That it may have selling facilities in keeping with its new manufacturing plant the Sunbeam Company has arranged to market its entire output of lamps through the Western Electric Company, Chicago. Its sales department will be removed to the Western Electric Company's building, No. 242 South Jefferson street, and this arrangement will give the Sunbeam Company an excellent selling organization.

THE JONES SWITCHES.

We illustrate in the accompanying engravings two styles of switches manufactured by J. Jones & Son, 67 Cortlandt street, New York.

Fig. 1 shows their standard "Baby" style; this is made in

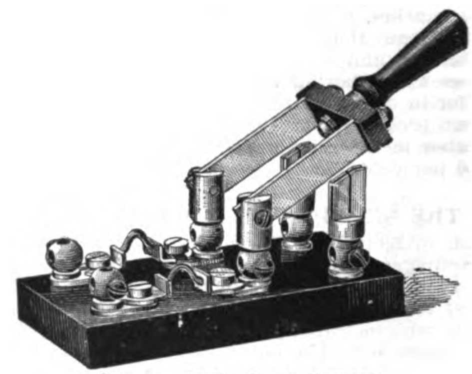


FIG. 1.—JONES BABY SWITCH.

smaller, or 25 ampere size on porcelain bases, single pole, double pole and triple pole, and on slate base, double pole, double throw. The other size, 35 amperes, is mounted on slate entirely. These switches are also carried with back connection for switchboard work, and with screw connection for panel boards.

Fig. 2 shows the all copper type, the bases in this style being slate only. They are carried in all sizes from 15 amperes up.

The workmanship on all of the firm's goods is the highest.

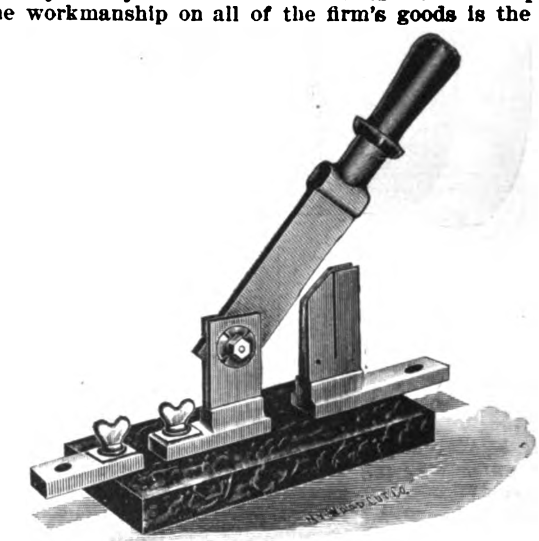


FIG. 2.—JONES ALL COPPER SWITCH.

The working parts are fitted to act to a nicety and the contact surfaces are made to make the proper bearings. One feature in the switch worth mention is the ability to adjust the friction of the blade between the leaves of the back post. One side of the back post is threaded, so that the screw going blade may be loosened or tightened between the two leaves and an adjustment obtained not to be found on any other switch.

OF INTEREST TO BUYERS.

WILKINSON MANUFACTURING COMPANY, Bridgeport, Montgomery County, Pa., manufacture one of the best mechanical stokers in the market, adapted to all forms of steam generative furnaces, kilns, etc. Its mechanism insures uniform thickness of fire, ample air supply for any rate of combustion. There are no clinkers. The operation throughout is easily managed. Catalogues are mailed on application.

GOLDMARK & WALLACE, 29 Chambers street, New York, are selling agents for the United States of the Koch woven wire tube dynamo brush.

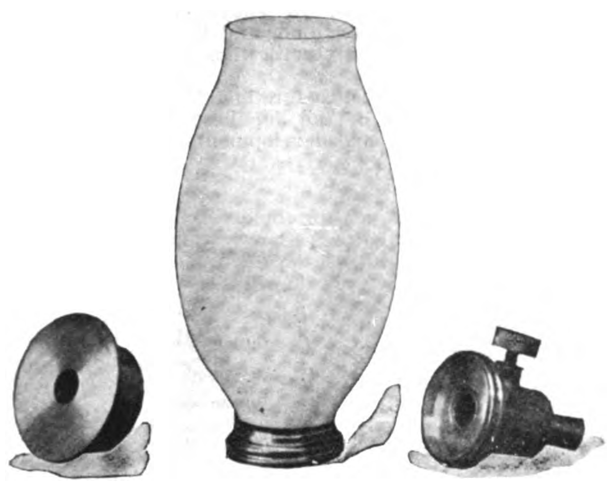
CHARLES N. MARTIN, silk manufacturer, 348 Canal street, New York, carries a full line of silk for insulating purposes.

PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., manufacture a full line of porcelain insulation for electrical purposes, knobs, cleats, motor cut-outs, tubes, main and branch cut-outs, rosettes, switches, etc., and manufacture to order any porcelain specialty desired. They are makers of the Laclede and Hercules Batteries.

THE PIONEER LAMP GAS-CHECK PLUG.

A special feature of the "Pioneer" inclosed arc lamp is the gas-check plug. This plug, illustrated in the accompanying engraving, consists of two parts so arranged as to form a chamber to which the gases of the arc have access. The plug is inserted in the upper end of the small inclosing bulb and closes the bulb against the ingress of air. A small amount of oxygen is, however, allowed to reach the arc so as to combine chemically with the volatilized carbon. Thus it will be seen that the "Pioneer" lamp has a double chamber for the gases formed by the arc, this double chamber consisting of the small bulb and gas-check chambered plug; in addition to these a large outer globe is also used.

This gas-check plug or "dead-air" chamber performs a most valuable function in the lamp. It permits the use of a small carbon at a very high efficiency, and reduces the amount of carbon consumption to a minimum; besides it permits of the continuous efficient operation of the lamp at the very smallest possible current. Hence it is that the "Pioneer" lamp gives more life for the amount of carbon consumed than any other lamp on the market and at the same time gives a light efficiency from 25 to 30 per cent. greater than is possible without the use of the "dead-air" chamber.



Gas-check Plug; (fits in mouth of Bulb). Enclosing Bulb; (surrounds the Carbons). Lower Carbon Holder; (supports the Bulb).

THE PIONEER ENCLOSED ARC GAS-CHECK PLUG.

One of the greatest objections to the inclosed arc is the falling off in candle-power toward the end of the run. In the "Pioneer" lamp this is practically overcome, the difference in the amount of light between the beginning and the end of a run of a pair of 7/16 inch carbons in this lamp not being noticeable.

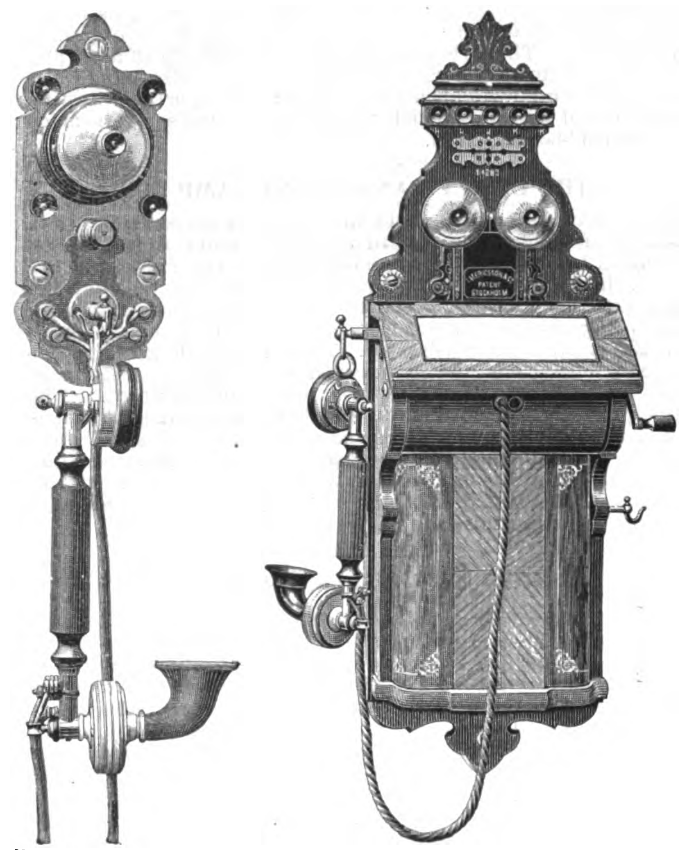
The gas-check plug of the "Pioneer" lamp is designed not only to act as a secondary gas chamber which retards the access of oxygen to the arc, but also to serve as a movable closure to the bulb, whereby the lamp operates just as well with a moderately crooked carbon as with a straight one. The simplicity of the lamp is such that little or no electrical skill is required to handle it; in fact, in many stores throughout the country "Pioneer" lamps are trimmed by clerks who have no knowledge of electricity.

SPRAGUE ELECTRIC ELEVATORS IN THE SIEGEL-COOPER BUILDING, NEW YORK.

Perhaps the most striking example yet afforded of the fact that the electric elevator has come to stay for all classes of work for which an elevator can be employed, is that presented by the elevator installation in The Siegel-Cooper Company's "Big Store" in New York. Reference has already been made in our columns to this installation, but it may be interesting to recall that the twenty-one Sprague electric elevators are now in daily operation, carrying passengers, employés, freight and packages to the various departments from the cellar to the six floors of the great building. The elevators installed are of the single and double-drum form gear type, according to the various uses to which they are applied. Each is equipped with the Sprague regulator and safety devices and their success has been most marked in every way, so much so that two more have recently been contracted for, which will be put in operation shortly, making in all twenty-three.

ERICSSON SWEDISH TELEPHONES.

It is now about three years ago that Messrs. Smith & Patterson, of No. 256 Broadway, began to introduce the celebrated Ericsson Swedish telephones. These instruments had already made for themselves a European reputation, no less than 300,000 of them being now in use in Norway, Sweden, France and Germany, and only recently they have been adopted by the Japanese Government. Since their introduction in this country they have been installed for interior work by no less than 200 firms in all kinds of situations. Thus on the banks of the Mississippi, where the dampness seems to affect most telephone transmitters those of the Ericsson type have worked without the least trouble for several years past.



FIGS. 1 AND 2.—THE ERICSSON SWEDISH LONG DISTANCE AND INTERIOR WALL SETS.

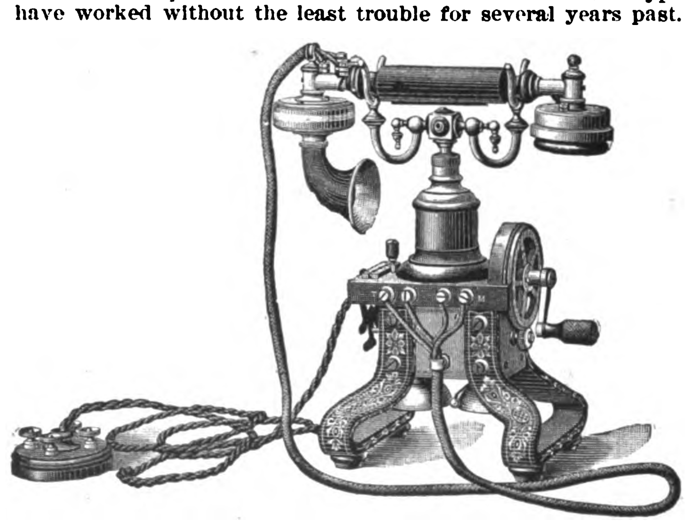


FIG. 3.—THE ERICSSON SWEDISH TELEPHONE DESK SET.

We illustrate in the accompanying engravings a number of different styles in which the Ericsson transmitter is arranged for the various characters of service.

Fig. 1 shows the instrument specially adapted for interior work. This is a battery call set, with vibrating bell, etc. As

will be seen the microphone is attached to the bar carrying the receiver; thus one hand suffices to carry the transmitter to the mouth as well as the receiver to the ear, leaving the other hand free for the recording of memoranda. This wall set is also made with the transmitter directly attached to the board.

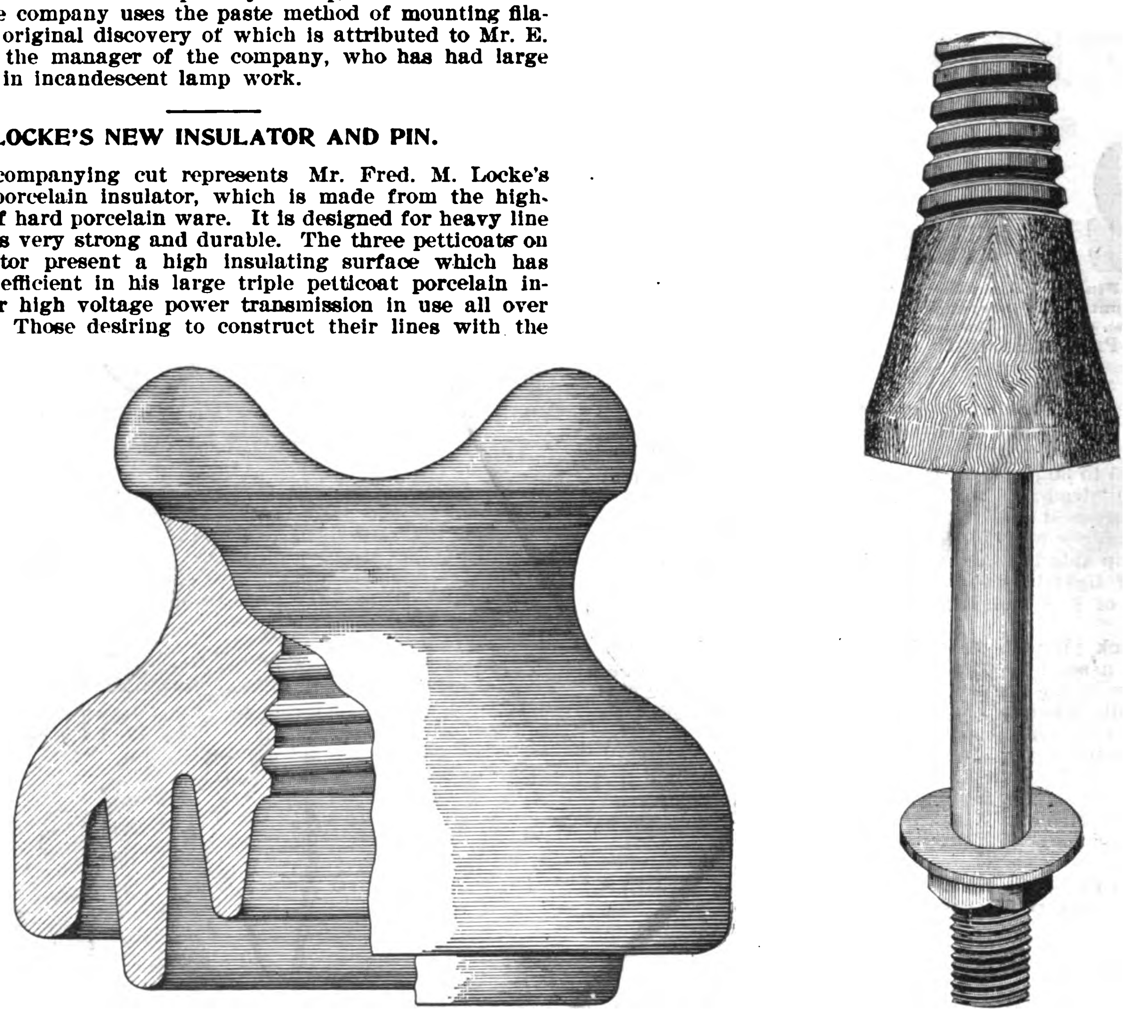
Fig. 2 shows a wall set specially constructed for long distance work. This was adopted by the Russian Government for use on its long distance lines. Fig. 3 illustrates the Ericsson Swedish desk set. This is a complete instrument, with magneto-generator and bells and rings through 25,000 ohms resistance. The instrument is highly finished and is an ornament to any office. The Ericsson telephone is made up in a variety of special forms. Messrs. Smith & Patterson also handle the Ericsson small switchboards, receivers and portable testing sets, as well as the Swedish telephone lineman's plyers made of "electro"-boracic steel.

THE LYNN INCANDESCENT LAMP CO.

The Lynn Incandescent Lamp Company have equipped a factory in Lynn, Mass., with special machinery for the renewal of burned out incandescent lamps. The subject is one which has attracted considerable attention in the lighting field and the progress of the Lynn Company has resulted in their being able to turn out first-class lamps at a cost much below the original purchase price. The lamps undergo forty-two different operations and six inspections from their receipt at the factory to the time they are ready for shipment. The utmost care is paid to them in all the various stages, and it is believed that the same lamps may be repaired almost indefinitely. The company uses the paste method of mounting filaments, the original discovery of which is attributed to Mr. E. T. Dwyer, the manager of the company, who has had large experience in incandescent lamp work.

LOCKE'S NEW INSULATOR AND PIN.

THE accompanying cut represents Mr. Fred. M. Locke's new porcelain insulator, which is made from the highest grade of hard porcelain ware. It is designed for heavy line work and is very strong and durable. The three petticoats on this insulator present a high insulating surface which has proved so efficient in his large triple petticoat porcelain insulators for high voltage power transmission in use all over the world. Those desiring to construct their lines with the highest insulation accompanied with strength and safety should secure them for their lines. The insulator is shown full size.



Locke Petticoat Insulator and Pin.

We illustrate also the new Locke steel pin, two-thirds real size. This pin has been designed for heavy work in combination with the strong porcelain insulator just shown. Its introduction will be greatly appreciated as such an article has been needed. These specialties are being made by Mr. Locke, at his factory, Victor, N. Y.

THE WELLMAN DUPLEX ELECTRIC ELEVATORS.

We were favored last week with a call from Mr. H. E. Heller, representing the Armitage-Herschell Company, of Buffalo, manufacturers of the new Wellman duplex electric elevators, for which Heller, Wellman & Curtiss, electrical engineers and contractors, of Buffalo, N. Y., are sole agents. This elevator, the invention of Mr. H. Robinson Wellman, embodies a differential gear with a novel application of electric principles. It is claimed that the motor is brought up to speed without an excessive rush of current in starting, and that through the leverage developed the load is gradually accelerated through a predetermined space of time. Cards showing the results of actual tests would seem to indicate a high efficiency for the Wellman elevator.

CIRCUIT BREAKERS IN JAPAN.

The immense strides which the Japanese are making in sciences and liberal arts is in nothing better shown than in its electrical development. In Tokyo electric lighting is the rule rather than the exception, and light and power stations there compare favorably with those of New York and Philadelphia.

There was in this city week before last Mr. Seiryo Mine, the accredited representative of the Japanese Government, sent to this country to study recent developments and improvements in the use of electrical appliances, and more particularly, the use of safety devices in connection therewith.

From New York Mr. Mine went to Philadelphia, where he visited the Baldwin Locomotive Works, the Pennsylvania Railroad, the plant of the Light, Heat and Power Company, and the Cutter Electrical & Manufacturing Company, whose circuit breakers or electric cut-outs have eliminated one of the chief dangers to the users of heavy electrical currents, that of fire and destruction to electrical apparatus. The interesting plant

of the Storage Battery Company and the great power station of the Union Traction Company were not forgotten, but it was with the Cutter Company that Mr. Mine spent most of his time, and expressed himself as being delighted with the mechanical and electrical skill as there shown in the development of this important device. The best part of two days was spent in this study, and the importance of some of the tests made would have been apparent even to one not as well versed in electrical matters as is this representative of the Mikado. Mr. Mine will return to Japan after visiting the Street Railway Convention now being held in St. Louis, and will take back with him a thorough knowledge of the particular branch of the electrical science which he was sent here to study.

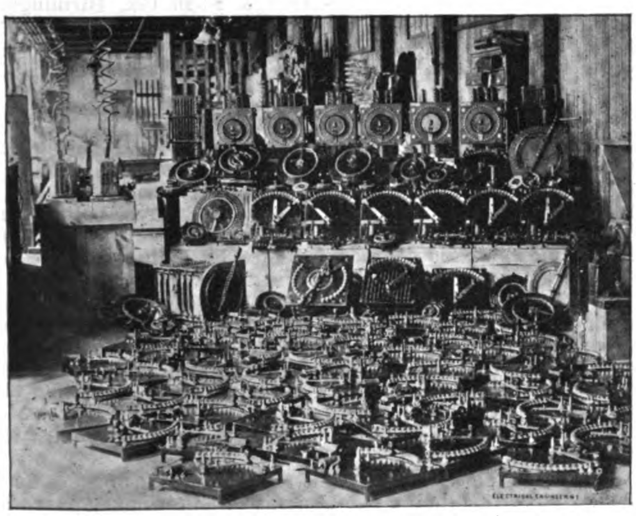
The fact that the Cutter Electrical & Manufacturing Company have already made several large shipments of their circuit breakers to Japan, reflects as favorably upon the progressive character of the Japanese as upon the energy necessary to introduce such devices in the far distant East.

When one realizes that the Japanese Government has in the Bank of England one hundred and fifty millions of dollars of gold and an equal amount of silver bullion, and that it is the intention of the government to spend this sum in furthering its mechanical, industrial and electrical enterprises, one begins to realize the position which these Yankees of the East will occupy at no distant date. In the mean time there is a field there which is well worthy of consideration by our manufacturers of electrical apparatus.

WARD LEONARD AUTOMATIC RHEOSTATS.

The Fire Department of New York and many other large cities have recently adopted rules as to automatic rheostats which are of importance to all parties using electric power.

The rules of the Fire Department of New York City, which went into effect last month, state: "Motors exceeding 1 h. p. must be protected by both fusible and magnetic circuit breakers, of which one at least must be double pole. The magnetic cut-out or switch must be so designed and adjusted that it will automatically cut off current from the motor whenever the supplying current is interrupted; both cut-outs shall operate



Leonard Automatic Rheostats.

automatically to cut off the current whenever its flow shall exceed, for one minute, the normal requirements of the motor by more than 30 per cent."

To meet the demand occasioned by this rule several manufacturers are offering automatic rheostats which have the double protection called for by the rule, namely, excessive current and failure of current.

The Ward Leonard Electric Company who have been selling such rheostats for about a year past report that for some time past they have been supplying these rheostats to European customers, who seemed to appreciate the importance of these desirable protective features more quickly than customers in this country.

We show on this page a group of these rheostats comprising part of a shipment to a single customer of the Ward Leonard Electric Company in Germany.

It seems odd that the German market should first show a vigorous demand for a device brought out in the United States, and this would seem to show that the Germans are keeping very close watch of progress in electrical lines in this country.

We learn that Mr. S. Bergmann, who has very extensive electrical manufacturing interests in Berlin, has recently secured from the Ward Leonard Electric Company the sole right to represent them in the sale of their goods in Germany, Austria, Russia, Belgium, Denmark and Sweden.

WESTINGHOUSE ENGINES ABROAD.

An order which the Westinghouse Machine Company recently received through its Paris branch for a 1,200 horse-power engine similar to those exhibited by that company at the World's Fair, would seem to indicate that some features of the great Exposition made substantial and lasting impressions on our foreign visitors. The engine is to be used in an electric lighting station in France.

THOMAS & HUNTER.

A firm of electrical contractors who have been in existence since only the first of this year are Thomas & Hunter, of Richmond, Va. The firm is composed of Maurice W. Thomas and Maurice Hunter, both of whom were connected with the Old Dominion Electrical Construction Company, of Richmond, until just before that company went into the hands of a receiver. Mr. Thomas was the traveling manager for this company, while Mr. Hunter was the engineer.

The new firm have already secured a number of good contracts, the most recent being the one for the wiring of the new buildings of the University of Virginia, for 3,000 lights in Armorite iron conduit. Another of their contracts is one for a municipal plant at Washington, N. C., for which they will be ready presently to receive bids on an automatic high speed safety engine of 150 horse-power, an alternating incandescent dynamo of 1,200 16 candle-power lights, and an arc dynamo of 50, 1,200 candle-power lights and two 85 horse-power return tubular boilers.

OSBURN ELECTRIC SUPPLY CO.

The Osburn Electric Supply Co., 294 and 296 Dearborn street, Chicago, have taken the agency of the "Crown" woven wire dynamo brushes, made by the Crown Woven Wire Brush Co., of Salem, Mass. They will carry a complete stock of the Crown, Crown "K," and Crown Alloy brushes, which will be the largest stock carried in the West. These woven wire brushes are becoming very popular with the trade, and the company are making a specialty of the brush business, being prepared to supply any style, size or shape in woven wire brushes of copper, brass or alloys. In congratulating the Osburn Electric Supply Co. on obtaining this agency, we feel that they will create a large demand for these goods in their territory.

NEW YORK NOTES.

THE PHILLIPS INSULATED WIRE COMPANY have given up their New York office and all business in future will be conducted direct from their general office and factory, at Pawtucket, R. I. The officers of this company are H. C. Adams, president; H. O. Phillips, treasurer and general manager, and H. C. Adams, Jr., secretary.

J. JONES & SON, 67 Cortlandt street, this city, have just issued a choice new catalogue, large octavo, 186 pages, devoted to electric lighting supplies and specialties, and embracing a great many things made exclusively by them. The supplies range from lamps to construction material, and the display is remarkably comprehensive. The concern will shortly issue a companion catalogue of their bell, gas lighting, telegraph, telephone and house supplies.

THE BALL & WOOD COMPANY is taking advantage of ante-election quiet in business to improve its shop equipment at Elizabeth, N. J. This company has recently reorganized the nickel plating department of its works and added quite an extension to one of its buildings for its accommodation. A new tool room has also been organized and equipped and every preparation made for an anticipated revival in business after November 3.

A. K. WARREN & CO. have permanently located themselves at 451 and 453 Greenwich street, in the Trinity Building, opposite their temporary premises in Desbrosses street, in the shops lately occupied by the Garvin Machine Company. Messrs. A. K. Warren and James Rich Steers, the proprietors, have secured in these premises greater facilities for handling their peculiar business, as the shop, store and offices are all on one large ground floor, greatly facilitating the handling of heavy machinery, which, in repair, constitutes the main part of their business. Their contract department for maintaining electric plants has met with such success that they have had to engage further experienced help to keep up with the demand for inspections. A visit to their stores will repay all users of electrical machinery, as it will familiarize them

with their complete system of handling emergency or breakdown work, which is now reduced to a science. Their telephone, 881 Franklin, is open night and day for calls on this class of work.

ADVERTISERS' HINTS.

THE WESTERN ELECTRIC COMPANY are now the New York agents for the "O. K." line and house wires made by the Phillips Insulated Wire Company of Pawtucket, R. I.

THE BERLIN IRON BRIDGE COMPANY show in their "ad." this week a cut of an iron water tower built by them for the Newport News Waterworks.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., renew lamps at twelve cents and pay the freight charges.

THE H. P. BALL MANUFACTURING COMPANY, 101 Beekman street, New York, manufacture switches and switchboards for all purposes and devote special attention to street railway orders. They also make theater dimmers, rheostats, distributing boards, etc., and are glad to submit estimates on all classes of work.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY state that there are now 9,000 of their arc lamps in service.

GREENE & DIKEMAN, 14 Cortlandt street, New York, offer "Ward" and "Knight" arc lamps at $9.50. They also advertise a new 150-hour lamp, brass finish, at $26.

E. H. KELLOGG & COMPANY, 243 South street, New York, supply oils for railways, dynamos, ice machines, engines, and, in fact, for all purposes where a lubricant is required.

THE ELECTRIC APPLIANCE COMPANY are the Western agents for the "Electra" Nurenberg Carbons, of which Hugo Reisinger, 38 Beaver street, New York, is the importer. They report that the excellence of this brand of carbons has made them very popular and the demand for them is steadily growing.

THE SAFETY INSULATED WIRE AND CABLE COMpany furnished all the insulated cables for the transmission of Niagara power to Buffalo. They were specified to test 20,000 volts, but 40,000 volts was the result of an actual test.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY installed twenty-three elevators in the "Big Store" of the Siegel-Cooper Company. They publish a long list of other buildings where their elevators are in service, and it includes many of the largest in the country.

NEW YORK NOTES.

J. D. MILLER & COMPANY are installing two 200 h. p. Fitchburg engines, together with boilers, piping, etc., in the plant of the Mt. Morris Electric Light Company, at 2283 Eighth avenue. The entire plant must be in running order by December 1.

MR. J. L. SOMOFF, has again started out independently to manufacture miniature lamps, Crookes tubes and induction coils. He has established a well equipped factory at 534 Linwood street, Brooklyn, N. Y., which he has equipped with the latest devices and standard instruments.

LONG BURNING ARCS.—Encouraging reports regarding the success of its long burning arc lamps continue to be received by the General Electric Company. A large number are in use in shops, stores, theatres and halls and they are now being largely purchased by mills, the shadowless light proceeding from the globe rendering them especially valuable for mill work.

THE STANDARD DICTIONARY. Funk & Wagnalls Company, New York, have just received a single order from one firm for 100,000 copies of their celebrated "Standard Dictionary of the English Language," amounting at retail to nearly one-quarter million of dollars. This is the largest single sale of so large a work ever made in America. Previous to this one large transaction, over 100,000 copies had been issued, and the company is still receiving many large orders from its subscription agents throughout the world.

STUCKY & HECK ELECTRICAL MFG. CO., (LTD.), 35 N. J. R. R. avenue, Newark, N. J., make a specialty of taking in old electrical machines and reconstructing them for entirely different purposes from those originally intended. There are very few shops where this class of work can be done, it is claimed. Their largest business that for which they are likely most favorably known is their repair work, on every system, armatures, power generators, motors, transformers, lighting dynamos, etc., also rewinding and constructing. Messrs. Stucky & Heck are both practical men, and, with a large force of efficient hands in their factory, are in a position to turn out work in a highly satisfactory manner.

WESTERN NOTES.

MR. M. M. WOOD, who is well known amongst the Western electrical trade, has accepted a position as electrical engineer to the Ohio Brass Company, and will hereafter be located at the headquarters of that company at Mansfield, O.

THE BALL ENGINE COMPANY, who throughout the long period of business depression have been strenuous to maintain the quality of their machinery, find a reward in the fact that their shops at Erie, Pa., are filled with orders at prices very considerably above those quoted by others and that they have work many months ahead. A number of these orders are from foreign countries and were entirely unsolicited.

THE ST. LOUIS IRON AND MACHINE WORKS have issued a very neat little brochure devoted to their heavy duty St. Louis Corliss engine, intended specially for use in the electrical field, to meet the conditions of great strength, constant regulation under wide changes of load, ability to stand sudden and continuous overload, and economy in operation. The pamphlet contains several cuts and many interesting details.

THE BORDEN & SELLECK COMPANY, 48 and 50 Lake street, Chicago, Ill., report fairly active business in their coal and ash handling machinery for power houses.The following recent contracts have been put in operation: Ash and soft coal handling conveyors for power house of North Shore Electric Company, Roscoe boulevard and California avenue; also power house of same company at Edgewater. Soft coal conveyors, steel storage tanks, etc., for carrying coal from side track through a tunnel under street and factory, delivering same into the battery of boilers, for James S. Kirk & Co., soap makers, North Water, near Rush street, this city. Contract has just been closed with the Chicago Library Company for anthracite coal and ash handling machinery for the new library building. Recent orders have been filled as follows: Tennessee Coal, Iron and Railway Co., Pratt City, Tenn; Howard Harrison Coal Co., Bessemer, Ala.; Choctaw Coal Co., Anderson, Ind. Ter.; Schloss Iron & Steel Co., Birmingham, Ala.; Toledo Traction Co., Toledo, O.; Elmwood Coal Co., Elmwood, Ill.; Dora Coal & Mining Co., Horse Creek, Ala.; Pablo Gamiz, Havana, Cuba.

NEW ENGLAND NOTES.

THE W. S. HILL ELECTRIC COMPANY, of New Bedford, Mass., have published some data in sheet form, giving the information necessary for designing switchboards and drilling holes for mounting switches. These sheets cover both 1, 2 and 3-pole switches. About 3,000 copies have been published, and those interested may procure copies by addressing the company.

JEWELL BELTING.—The Jewell Belting Company, Hartford, Conn., have recently, Mr. C. L. Tolles reports, taken some good contracts for large belts in the following places: South Bend, Ind., Electric Company, one 58-inch double, 104 feet long, and one 30-inch double; Albany, N. Y., Illuminating Company, 120 feet of 60-inch three-ply. Additional to these are orders for electric belts of several sizes from various parts of the country.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., notwithstanding the general distress among manufacturing concerns, report that their plant is fairly well employed. At no time during the year have they run on short hours, and are now employing 400 men, running 10 hours, 6 days a week. They have contracts on hand to keep their plant employed on full time for the next two months. They have no very large contracts on hand at the present time, but a great deal of small work. Some of this may be mentioned as follows: For the L. D. Brown & Son Co., at Middletown, Conn., fireproof power plant and also a new dye house; steel framework for the Fire Department Building, at Worcester, Mass.; power station for the electrical equipment of the N. Y., N. H. & H. R. R., at Stamford, Conn.; machine shop for the Baush & Harris Machine Tool Company, of Holyoke, Mass.; new building for the Woonsocket Electric Machine and Power Company, of Woonsocket, R. I.; new steel bridge for the town of Green, Me., including a second bridge for the Cabot Manufacturing Company, at Brunswick, Me., and smaller bridges at Auburn, Pembroke, Turner, Buckfield and Bridgeton, Me.; a new iron roof for Randolph & Clowes, Waterbury, Conn.; steel bridge for Somerset County, N. J., located at Finderne, besides other smaller contracts.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. NOVEMBER 4, 1896. No. 444.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—VI.

BY LIEUT. B. A. FISKE, U. S. N.

THE ENGINE TELEGRAPH.

THE office of this instrument is to signal to the engine rooms the speed and direction at which it is desired to run the engines.

The telegraph for each engine consists of a transmitter and a receiver, in each of which is an arc of resistance wire. The ends of the resistance wires of transmitter and receiver are connected together by large copper wires, so that they form, with the galvanometer, a "Wheatstone bridge" circuit (see Figs. 9 and 10); and since the two arcs of wire are exactly similar, the galvanometer will not deflect, if the contacts to which the galvanometer is joined are placed on the resistance wires at similar points, such as 1.1, 2.2, etc. In the actual apparatus, the contacts of the galvanometer are attached to the levers on the instruments; so that, if the operator at the transmitter places his lever at any point, the galvanometer will not deflect, if the operator at the receiver places his lever at a similar point.

The operation, then, of using the telegraph is as follows:

The operator on the bridge, or in the pilot house or conning tower of the ship, wishing to signal an order, places his lever opposite the graduation on the transmitter indicating the order. The operator in the engine room moves his lever until the galvanometer comes to zero, and then looks at the face of his receiver, to see the graduation opposite to which his lever then is.

Besides the galvanometer just mentioned, there is another galvanometer in series with it. This galvanometer is on the bridge, and is subjected to the same electrical current as is the galvanometer in the engine room, and is moved to the same extent. The operator on the bridge, therefore, by looking at this galvanometer can tell whether or not the galvanometer in the engine room is at zero; or, in other words, can tell whether or not the operator in the engine room has moved his pointer to the signaled position; so that the galvanometer on the bridge acts as an answering signal to the operator there. The galvanometer in the engine room is mounted in a vertical position on the lever of the receiver, so that the galvanometer and lever move together. (See Figs. 11 and 16.) Its electrical connections are such, that if the needle points in any direction, the act of moving the lever of the receiver in that direction will bring the needle toward zero. Furthermore, the sensitiveness of the galvanometer is so adjusted during installation that the amount of deflection of the needle shows the amount of movement necessary to give the lever. If, therefore, the levers are at 75 and the transmitter lever is moved to 90, the receiver galvanometer will at once point to 90. When the needle is at zero, it is in a line from the center to the indicating finger on the lever; so that, in order to bring the needle to zero, the operator at the receiver moves his lever toward the needle and until it is directly opposite it. In other words, the mode of procedure of the operators, both on the bridge and in the engine room, is the same as it is with the ordinary mechanical engine telegraph.

The receiver's galvanometer, however, owing to the vertical position in which it stands, is not absolutely exact. It is possible to make with it an error of two or three revolutions.

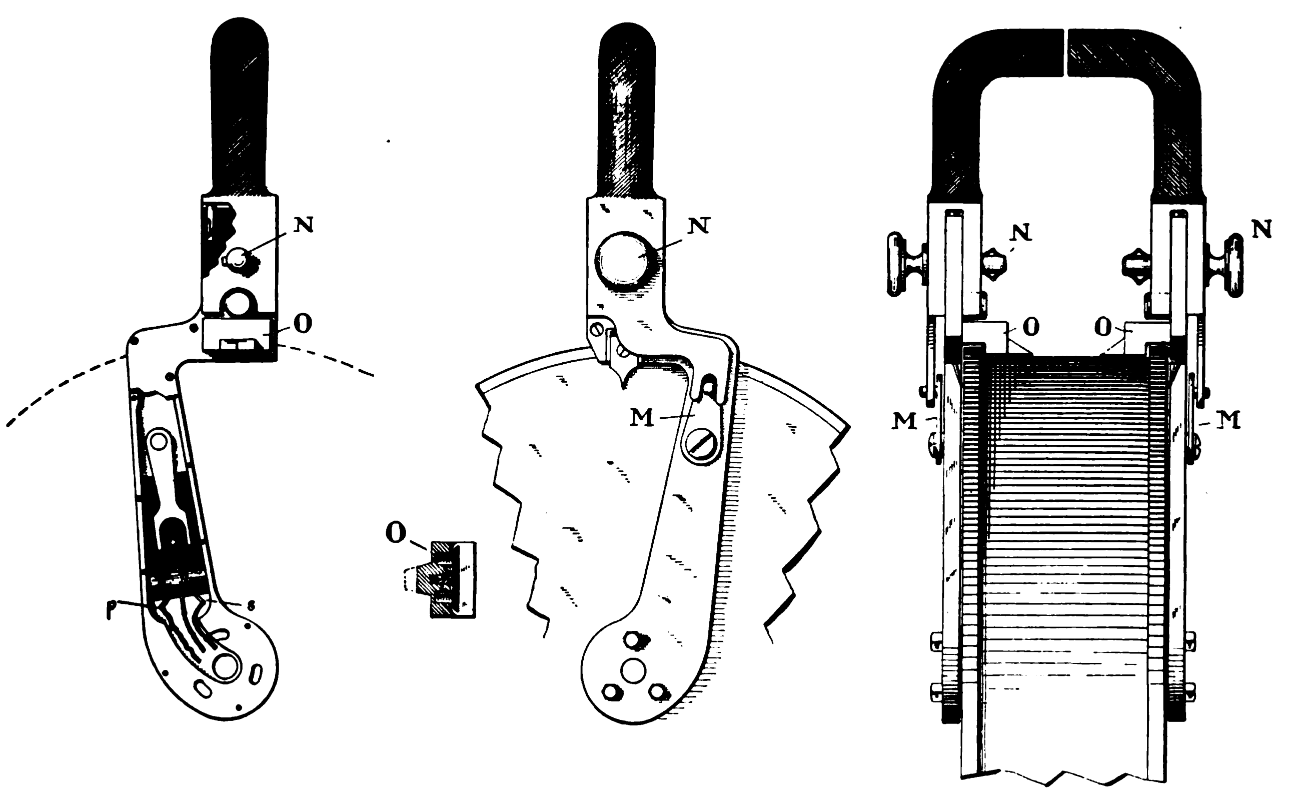


FIG. 12.—TRANSMITTER HANDLE OF ENGINE TELEGRAPH.

This error is of no consequence in the ordinary use of the engine telegraph, but for squadron sailing greater exactness is desired. To insure this, an auxiliary galvanometer, g', lying in a horizontal plane is placed directly below the receiver. (See

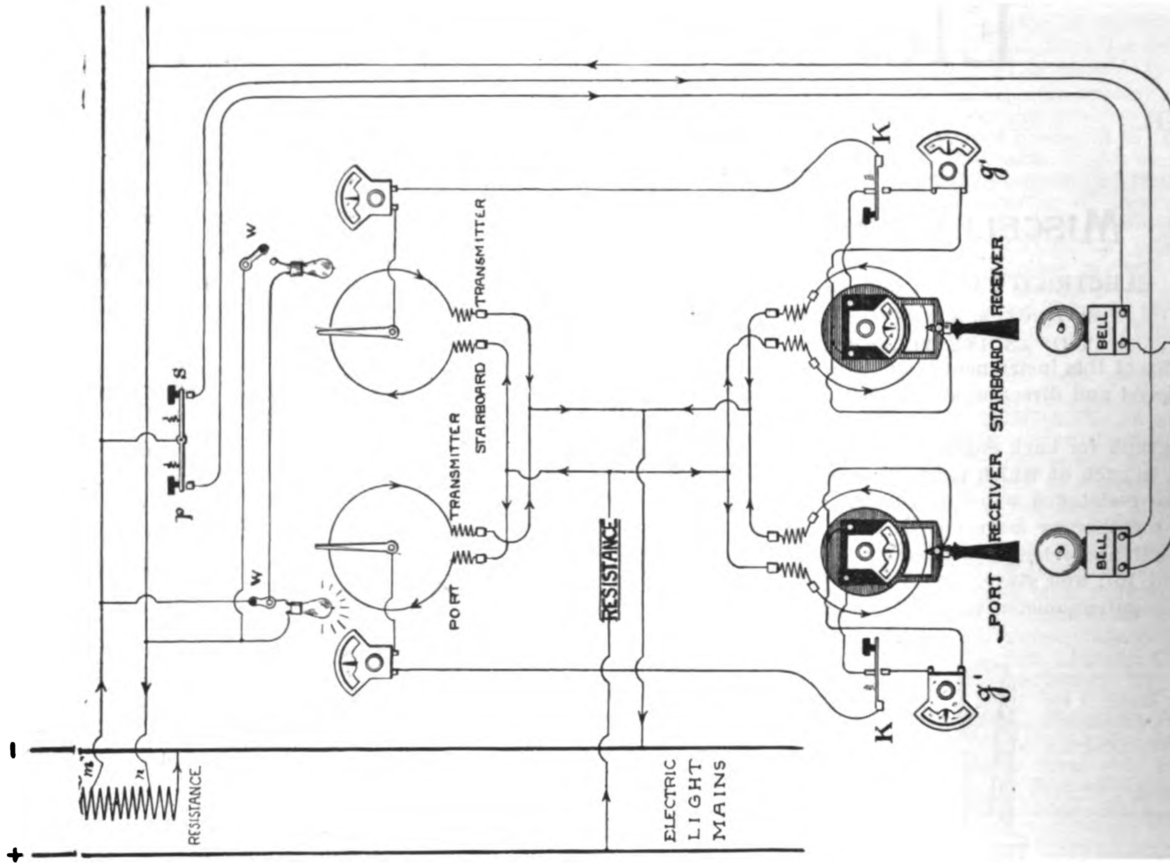
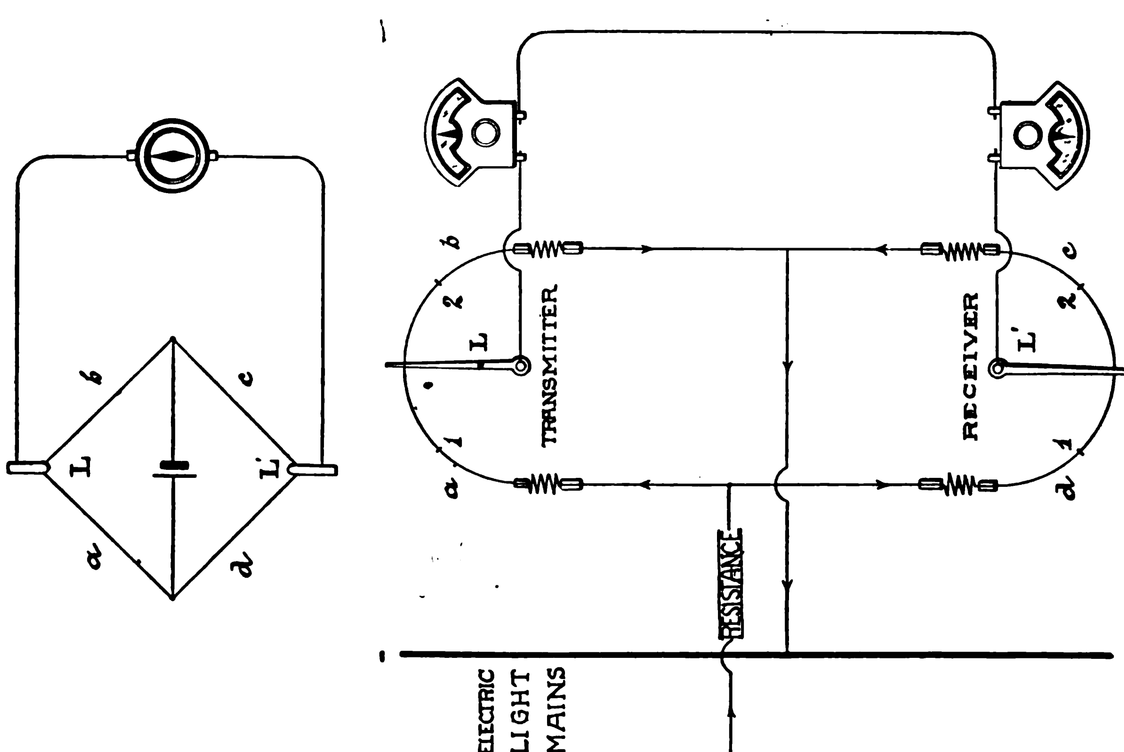


Fig. 11.—Engine Telegraph, Diagram of Electrical Connections.



Figs. 9 and 10.—Engine Telegraph, Diagram of Electrical Connections.

Figs. 11, 16 and 17.) Ordinarily, this galvanometer is not in circuit, and no attention is paid to it; but if it is desired to get a careful reading, it is merely necessary to press the key, K, on its top and to move the lever of the receiver until its needle comes to zero. The act of pressing the key on top of this galvanometer puts the current through it and out of the vertical galvanometer, which is ordinarily used, but does not disturb the galvanometer on the bridge.

The expression, "galvanometer needle comes to zero," means that the galvanometer needle comes to a marked position in the middle of the scale, but does not mean that it comes to its position of rest. There would be an objection to having the galvanometer needle come to its position of rest, to get the reading; because the needle will take its position of rest, not

only when the receiving and transmitting instruments indicate the same thing, but also if the battery fails, or if the circuit is broken; so that the operators might think the system was in balance and operating properly, when, as a matter of fact, it was not operating at all, and would fail the first time they attempted to use it. For this reason, each galvanometer needle is bent away from the middle point marked on its scale, so that its position of rest is about 1/16 of an inch from this mark; but the electrical adjustments are such that, when the levers of the transmitting and receiving instruments are at similar places, the "bridge" is not exactly in balance, but is person may have displaced the lever. But as soon as they see that this does not alter the position of the needle, they know that the instrument requires attention. In other words, this system detects itself, if it gets out of order, and reports itself at once, instead of waiting until some one tries to use it, and then, failing in an emergency, as mechanical telegraphs often do.

The apparatus may be operated either from a dynamo current or from a storage battery, or primary battery, or dynamotor. In Figs. 10 and 11 it is shown as operated from the regular electric light mains of a ship, a suitable resistance, about 38 ohms, such as a Carpenter rheostat, being inter-

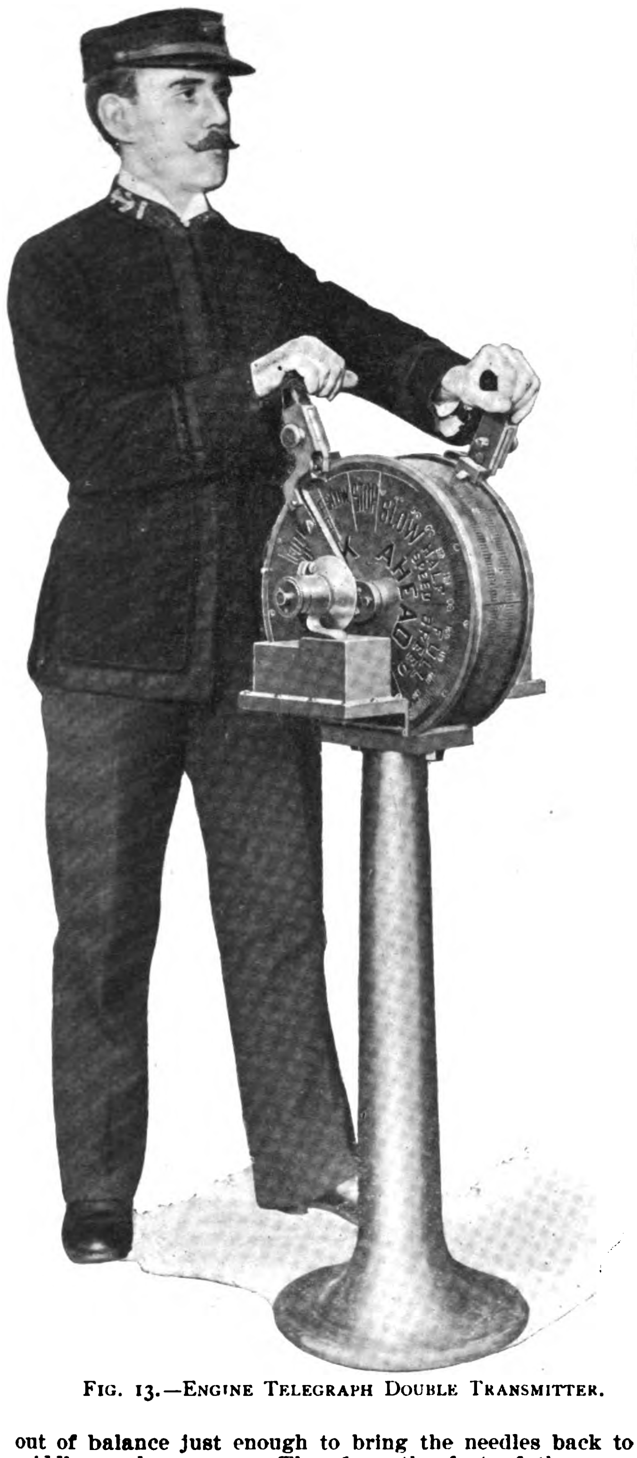


FIG. 13.—ENGINE TELEGRAPH DOUBLE TRANSMITTER.

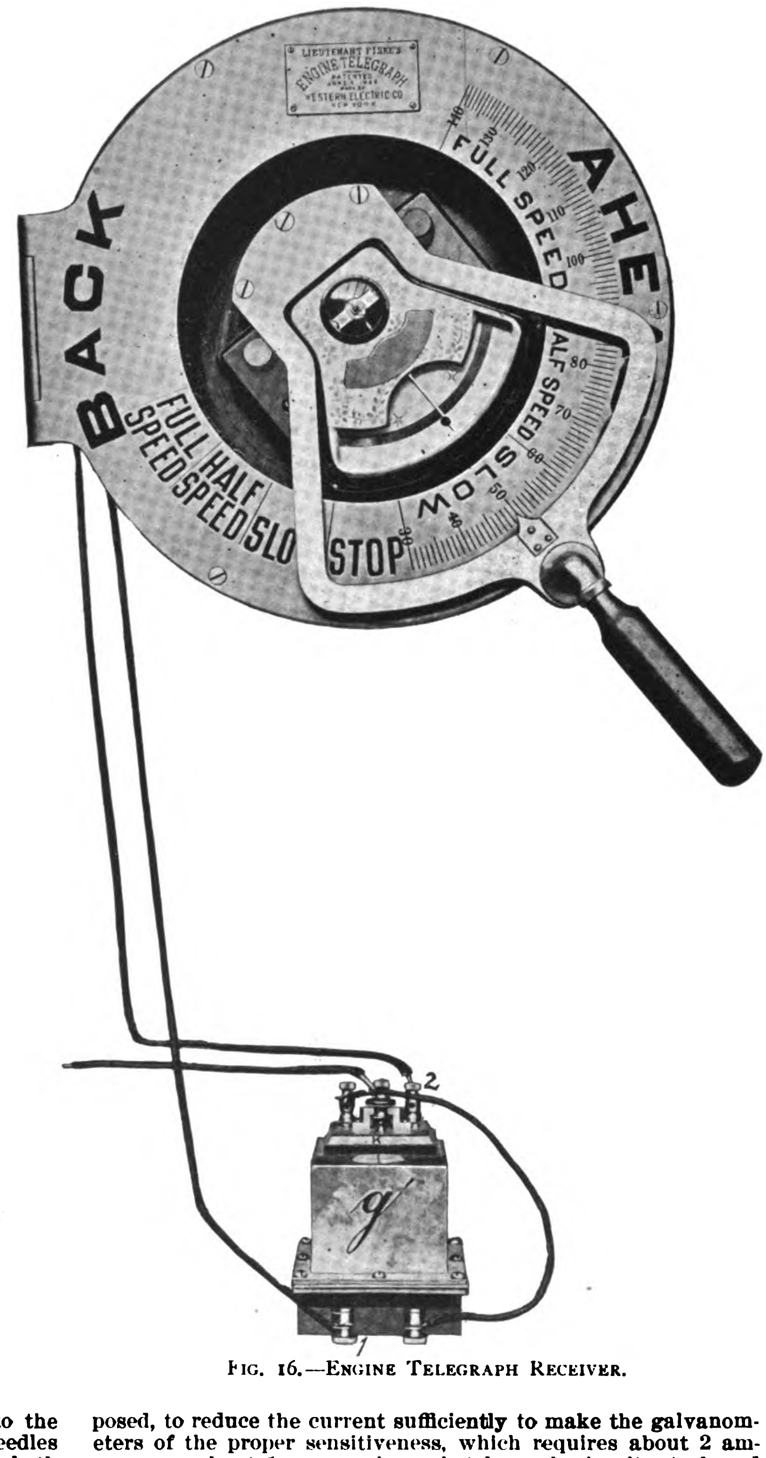


FIG. 16.—ENGINE TELEGRAPH RECEIVER.

out of balance just enough to bring the needles back to the middle marks or zero. Therefore, the fact of these needles being at zero is proof that the circuit is in balance, that both transmitting and receiving instruments indicate the same thing, and that the whole apparatus is in perfect order. If, therefore, the operators at each end see that their needles are at zero, they know that everything is all right; but if at any time they see the needles are not at zero, they know that something is wrong. The first effort will naturally be to move the lever, in order to return the needle to zero, thinking that some posed, to reduce the current sufficiently to make the galvanometers of the proper sensitiveness, which requires about 2 amperes, or about 1 ampere in each telegraph circuit, starboard or port, or ½ ampere in each resistance wire. As shown in Fig. 11, one pair of connecting wires is made to do the service of connecting both transmitters to both receivers. The resistance of each arm of the "bridge" is about 3 ohms.

The circuits of the bells and of the lamps which illuminate the transmitter are connected to the dynamo circuit through a resistance as shown in Fig. 11. The lamps for illuminating

the transmitter are lit by turning the small screws, W, Fig. 14, at each side, and can be taken out and replaced by others if found defective. These lamps are about 1 candle-power,

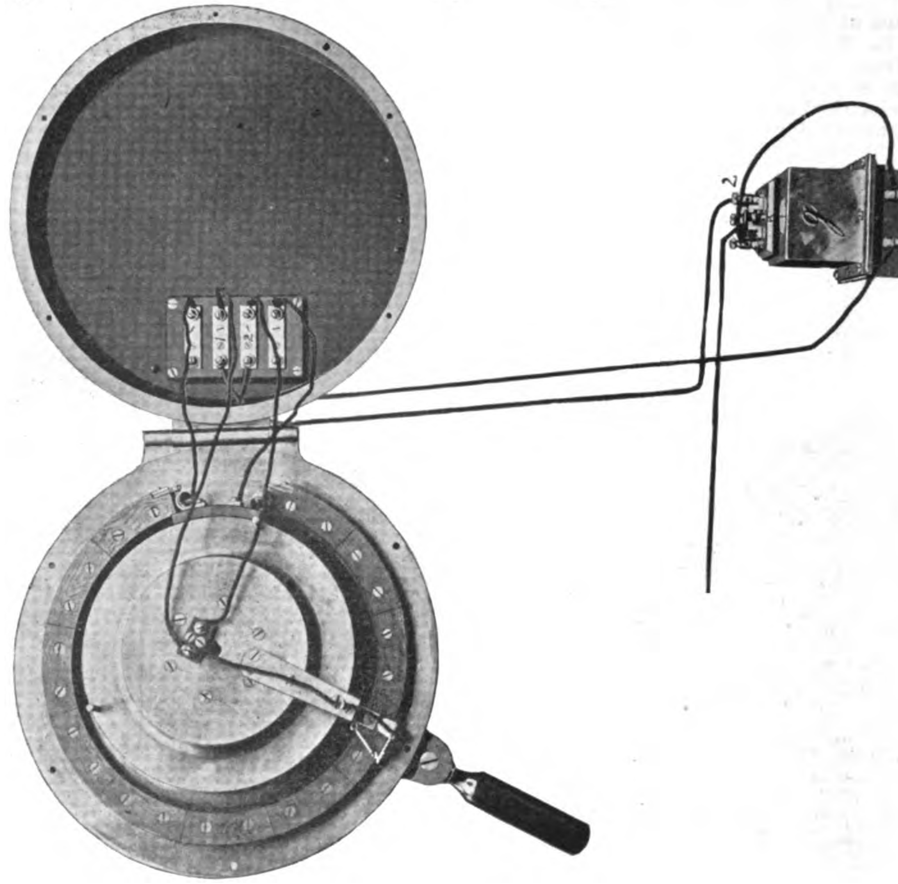


FIG. 17.—ENGINE TELEGRAPH RECEIVER SHOWING CASE OPEN.

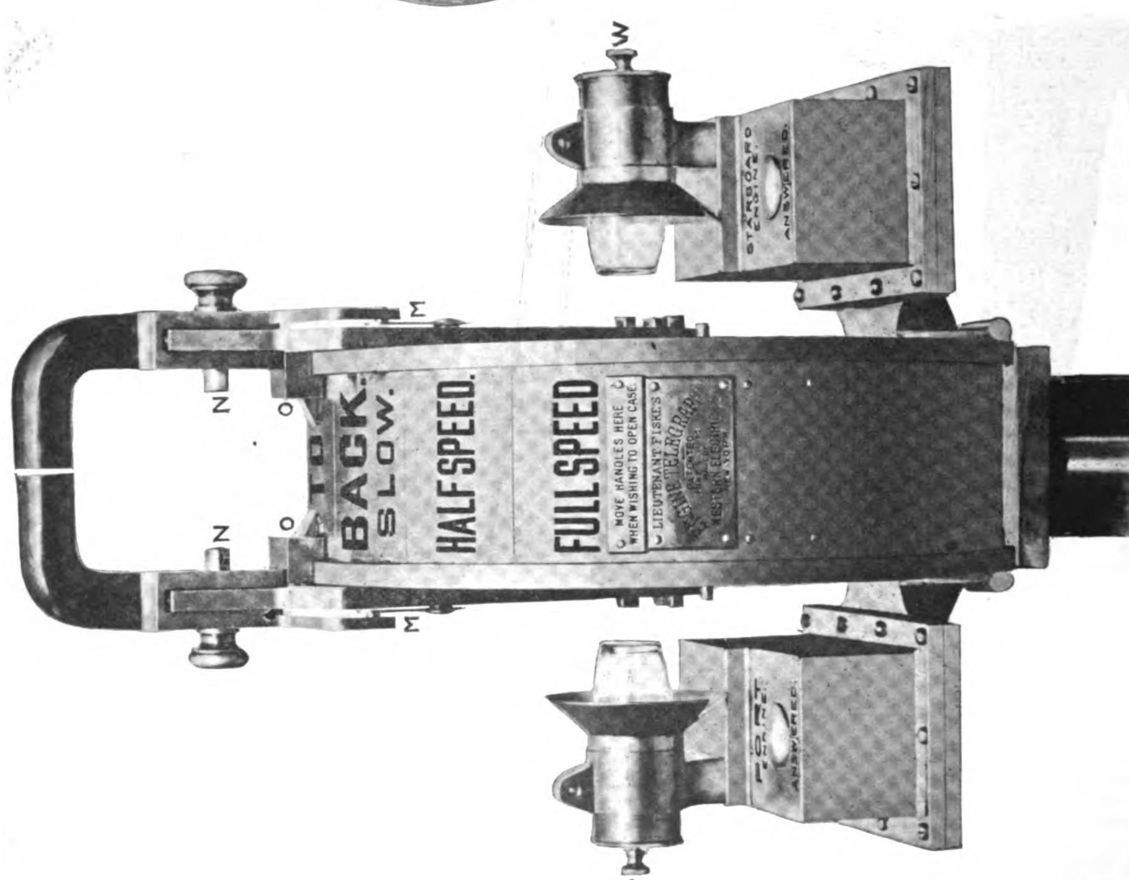


FIG. 14.—ENGINE TELEGRAPH.—REAR VIEW OF DOUBLE TRANSMITTER.

and are placed inside the reflectors shown on top of the galvanometer cases, g, on each side of the transmitter. The lamps and bells usually require about 10 volts each; so that the difference of potential between m and n, Fig. 11, should be about 10 volts.

Any part of the apparatus, including the galvanometers, can be taken apart, examined and repaired, if necessary, by a careful mechanic.

The arcs of resistance wire in the transmitter and receiver

on which the contacts move are covered with vaseline before being installed, in order to prevent undue friction between the wire and the traveling contact. These wires should be examined from time to time and more vaseline put on as required. They should always be covered with a thin layer of vaseline or oil.

The act of grasping one of the handles of the transmitter closes the electrical contact, P or S, on the lever (see Figs. 11 and 12 and 14) by means of the lever, M, and rings a bell in the corresponding engine room. The bell contacts are covered in and arranged as shown in Fig. 12, and well protected from dirt and water. Water in these contacts will not close the circuit, but if they should get dirty they might not permit the closing of the bell circuit when desired. The transmitter handles may be taken off by pulling out the pin, N. These handles are held in position on the rim of the transmitter by means of the spring friction piece in the sliding piece, O.

In case of any trouble with the engine telegraph, the difficulty, in nine cases out of ten, can be traced to some imperfect contact. The contacts most likely to require attention are those of the key, K, on the top of the small horizontal galvanometer, g', under the receiver. If these contacts fail to touch each other, the galvanometer on the bridge, and the vertical galvanometer in the engine room will not receive any current, and, therefore, their needles will not deflect.

A considerable amount of insulated resistance wire, about 2½ ohms, is added to each end of each arc of wire, as shown in Figs. 10, 11, 15 and 17, in order to increase the amount of resistance in circuit of this kind of wire, in comparison with the resistance of the copper connecting wires. This makes the resistance of the resistance wires in each arm of the "bridge" about 3 ohms. The reason of this is that copper changes in resistance with change of temperature, and it is not desirable to have changes of temperature to alter materially the resistance of the circuit. The resistance wires, a b and c d, are of No. 22 American gauge, and made of rangefinder alloy, i. e., 70 parts copper and 30 of nickel, with a resistance of about ⅓ ohm per foot. The copper wires connecting a b to c d are No. 6 gauge, being made so large to avoid copper resistance. The bell wires, galvanometer wires, electric light wires, etc., must not be less than No. 16 gauge.

As shown in Figs. 13, 14 and 15, both the transmitters are mounted on one pedestal and form a double transmitter.

When there is but one engine, the apparatus is correspondingly simplified and cheapened. In the case where it is not necessary to signal any exact number of revolutions, the graduations for revolutions on both transmitter and receiver, and the horizontal galvanometer, g', under the receiver, may be omitted and the instruments made much smaller and cheaper.

In the case where more than one double transmitter is required, as in the Brooklyn, where three will be required, a switch is placed on the pedestal of each double transmitter, which carries four knife contacts. By moving this switch in one direction, or the reverse, the connection is made or broken to both ends of the resistance wire, a b, and both ends of the galvanometer wire. To get ready any transmitter for use, then, it is merely necessary to move its switch in the direction marked on the pedestal. When any such transmitter is not in use, its switch must be moved to the "not in use" mark.

The covers of the transmitters and receivers are made to open on hinges, as shown in Figs. 15 and 17, respectively, so that the connections are readily accessible for examination. Before endeavoring to open the transmitter the user must take off the handles.

The copper leading wires within the transmitters and receivers that are connected to the forward ends of the arcs of resistance wire are covered with yellow braiding; those connected to the after ends with green braiding; those to the galvanometers with green-yellow braiding; those to the bell contacts in the transmitter handles with red-yellow braiding, and those to the lamps with black braiding.

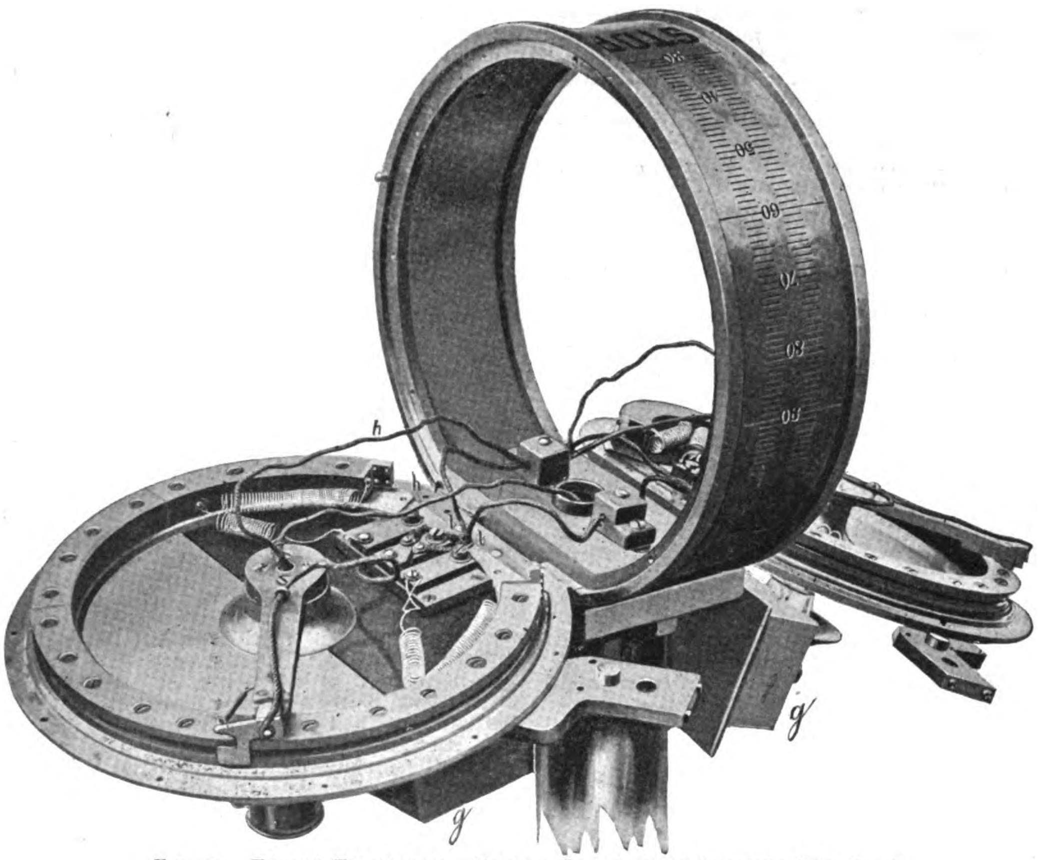


FIG. 15.—ENGINE TELEGRAPH.—DOUBLE TRANSMITTER SHOWING CASE OPEN.

For engines whose speed ranges between 30 and 140 revolutions, the arms which carry the contacts that move over the resistance wires in both the transmitters and the receivers are so connected to the handles that, when the handles are at 85 revolutions ahead, the contacts are at the middle points of their respective arcs; and in constructing and installing the instruments the 85 revolutions mark is the place where the most care is taken to make the instruments balance exactly. The reason of this is that, since the resistance wires are never exactly uniform, the further away the contacts get from the middle points, the more error is apt to creep in; and by making 85 revolutions as the middle point, the contacts do not get far away from it in either direction, even when going as fast as 140 revolutons, or as slow as 30; so that errors as great as ½ revolution are rarely found.

For engines whose maximum speed is greater than 140 revolutions, or less, the same rule applies, though the middle graduation will, of course, be some number greater than 85, or less.

This engine telegraph was given a year's trial in sea service on board the U. S. S. New York. The test having been successfully passed, the apparatus has since been installed on

board the U. S. S. battleships Indiana and Massachusetts It is now being installed in the Texas, and is to be installed in the Brooklyn.

Weight of double transmitter complete, 140 pounds.
Weight of receiver complete, 80 pounds.
Diameter of face of transmitter or receiver, 14⅝ inches.

ELECTRIC TRANSPORTATION.

STREET RAILWAY TRUCKS.[1]

BY J. N. AKARMAN.

AFTER a long and expensive experience, it has at last been generally conceded that trucks are necessary for carrying a modern street car. The term truck in this case means the separate frame work for holding the running gear of an electric car; namely, the wheels, springs, brakes, motors, etc. This being the case, the question arises as to what form or type of truck is best adapted to the purpose, and the object of this paper is to endeavor to give some hints to street railroad men which will enable them to solve this question themselves. In doing this, it will be necessary to explain the principles involved, the requirements of the service, and show where single and where double trucks are most desirable.

When motors were first placed upon street cars, it was believed that there was no necessity for special construction, or any marked departure from the prevailing horse car practice. The idea of a separate truck had not even been conceived. We found Van Depoele placing his motors upon the front platform, and using chains and sprocket wheels to carry the power to the axle. Sprague made a short step in advance and in the right direction by carrying his motor on links from the car body resting one end through sleeves, on the axle. This improvement preserved the distance always the same between the motor and the axle, but the rising and falling of the body imparted a racking motion to the motors, which was destructive to the cars. Both of these systems were radically wrong, and might have been known to be so, from a study of the steam coaches of fifty years ago, and from the steam wagons of fifteen or twenty years previous.

Thie idea of a separate truck was first conceived about the year 1885, but it was not until the latter part of 1887 that, in its concrete form, it was put into operation. The first truck consisted of a continuous upper chord made of bar iron in the form of a rectangle. Its purpose was to support the car body, the sills of which rested on its frame. The sides of this upper chord were re-enforced by heavy oak sub sills to which the chord and the pedestals were both firmly bolted. This form of frame kept the body square and took many of the strains on itself; but it has been abandoned, and in abandoning and using separate bars, I think we have been drifting away from the best practice, for it had a very important advantage in preserving the squareness of the body and truck. In addition to this upper chord, there was a bar extending around the truck to which the bottom of the boxes was fastened.

In all the early trucks the frame rested directly on the journal boxes. The jar and concussion which resulted crystallized the metal, injured the motors, and made it impossible to keep bolts and nuts tight; and was the cause of a rapid destruction of the whole truck. A remedy became an imperative necessity. So elasticity or cushioning of some sort was resorted to; and the first effort in this direction was made by placing a thick piece of rubber upon the top of the journal box between it and the axle box frame. While the principle was right, the means employed was of little value. The rubber at best had only a trifling elasticity, and was not durable and did not prevent the box from jolting.

Then a spiral spring was tried upon the top of the box. This was an improvement as it had a certain amount of motion; but the space available over the box was so small that a very stiff spring had to be used; so stiff in fact was it necessary to make the springs that they were but little better than the rubber. It was found that springs in this position had the additional disadvantage of aggravating the rocking of the box from side to side; but by widening the box at the bottom, or adding ears so as to form spring seats, it was found possible to give each box two springs, one on each side, and of ample diameter and length so that they would carry the load with ease and have sufficient motion. Thus placed they had the advantage of carrying the box perfectly steady, preventing entirely the rocking and unsteady motion. (It should be noted here that the motors were carried on the truck and were in no way attached to the car body nor connected with its motions.)

So far as I can learn, the first car body carried on a separate four-wheeled truck was run on the Scranton and Suburban Railway Company in Scranton, Pa. About the same time, the Boston and Revere Beach Railway Company in Massachusetts had a car, the body of which was mounted upon a truck; from the frame of the latter, the motor was carried in the modern fashion. This car was operated under the eyes of the officials of an electric railway company, who watched its operation from day to day with the most careful attention, and it required but a few weeks of service to demonstrate that the principle was a great one, and that a very important advance had been made that was to mark an era of success in the operation of electric cars.

These first trucks, although involving nearly all the essential features of the modern trucks, were by no means perfect, and the conditions of the service soon suggested modifications. The first of these was to make the removal of the wheels and axles as easy and practicable as they had been with the jaws and oil boxes used on the old horse cars. The form which the improvement took was the making of the jaws a part of the motor truck frame, so that upon jacking up the truck the wheels could be rolled out. This was an essential feature recognized by all truck builders, and has been embodied in every successful truck which has been constructed.

Up to this time brakes had been invariably hung from the body of the car. But it was soon found that brakes upon electrics were a very much more important feature than they had been upon horse cars. The high rates of speed and greater weight of the cars not only made stopping more difficult, but the shortness of stops to avoid accidents was found to be important. The brakes were first suspended from the sills of the car, and the sinking of the body under a load left the shoe so far from the wheels that in applying the brakes the slack of the chains was increased and could not be taken up without considerable delay. The remedy was simple and consisted in suspending the brake rigging from the axle box frame in such a way that it was not subject to the action of the body springs.

The change in the brake rigging from the car body to the truck frame brought another evil which had been of slight importance heretofore. This was the longitudinal rocking or pitching of the car body, technically known as galloping, which was greatly increased under higher speed, and is also futher increased by lengthening the car bodies. This motion is not only excessively unpleasant to passengers, but very destructive to the trucks, motors and track. When the brakes were hung from the car body it was possible to check this oscillation by a slight application of the brake, but the change in the hanging of the brake made this impossible, and remedies became imperative. The first thing that was done as a remedy was to increase the wheel base, but this did not prove to be of much advantage. The first success as a remedy appears to have been made by extending the sides of the truck, and on the extension pieces mounting an elliptic or half elliptic spring. The latter method with the half elliptic spring has been the most successful preventive tried. The necessity for overcoming the oscillation was considered so important, and the success of this device so great that a series of inventions were and are being brought out for the purpose of accomplishing the same result. The so-called extended spring base which is combined with the half elliptic springs has, in my judgment, been the best solution of the problem up to the present time. It is conceded that the equalization of the wheels to carry the load according to the practice on steam roads is out of the question with a car which has only four wheels.

As time went on and experience was gained one point was gradually made more and more evident, which was that a motor truck was a locomotive in every sense of the word, and for success must be governed in its construction by the same general principles that are involved in the construction of a locomotive machine.

As a result of the best information and from large experience, I believe the ideal four-wheeled truck for electric cars at the present time is one having the fewest number of parts in its construction, in which the side pieces of the main frame are single forged bars connected across the ends by bars either bolted or welded on so as to make the frame one continuous piece. This frame is carried by springs from the journal boxes and itself carries an upper chord; likewise, a continuous rectangular piece which has suitable seats for the springs. This upper chord is recessed to take the bolts and spring seats, and leaving its upper surface flush. The ends are carried by the half elliptic springs, while the spirals are placed at the journal boxes. The brake should be hung by links.

So much for the form of construction of a good type of four-wheeled trucks, but what of the disadvantages of four-wheeled

[1]Abstract of paper read before the Am. St. R'way Assoc. St. Louis, Oct 19-23, 1896.

trucks in general? Taken at its best, the four-wheeled truck is an uncomfortable carriage and a veritable track destroyer, and should only be used according to the best judgment of many of our wide-awake railroad men, where cars are run at comparatively slow speed, and with moderate length of car bodies. Where it is desirable to run at higher rate of speed in suburban service the damage to the track becomes so great that it should preclude its use. The increased length of wheel base made necessary makes it hard on curves.

The only alternative is to use a double truck car with swivel or pivotal trucks. The advantage of this form of truck is very great, and while nearly every one is familiar with its good qualities in a general way, I hope I may be pardoned for going into details which are not so well known. They are easy on curves to a degree that would hardly be credited by those who have only been familiar with four-wheeled cars. The greater number of wheels not only reduces the weight on each wheel, but correspondingly reduces the blow when the wheels strike a joint or a low place in the track. This is still further diminished by what is known as "equalization," which practically places the car body at the central point of the truck, so that each wheel in rising or falling in passing over any imperfection in track elevates the load a distance but half as great as its own rise.

Oscillation, whether longitudinal or transverse, can be completely done away with by the use of double trucks. While the trucks conform closely to all the irregularities of the line, the body can move forward with but very little influence from them. The conditions, however, are not altogether in favor of the pivotal truck. As, for instance, if all the weight is used for adhesion it is twice as expensive in use as a four-wheeled truck. If two motors are used, it only has 50 per cent. of the propelling power. In its ordinary form it makes a wide body necessary and hence is out of place in narrow streets or places where traffic is very heavy. It also has the disadvantage of putting the body at a greater height than is necessary with four wheels.

But it meets a great many of the requirements for fast suburban service, and has been indorsed with great satisfaction, but the objection which I have just mentioned precludes its use in many cases where it would have otherwise been desirable. Now the remedy for nearly all these objections has been found in what is known as the "maximum traction" truck.

The "maximum traction" truck may be defined as a pivotal truck in which the load is eccentrically placed in relation to the four wheels. Two of them receive only a sufficient amount of weight to keep them upon the track, while the others take the remainder of the load. In practice it is found that 80 per cent of the weight may be placed on the driving wheels, while 20 per cent. is used for guiding. Upon applying these trucks it was found that it was not necessary to have the wheels of equal size; that a large pair of driving wheels and a small pair of idle wheels can be used. The large pair used as driving wheels being very near the pivotal point have a comparatively small amount of swing, and can be allowed to rise within the floor timbers, while the small wheels moving through a much greater arc easily clear the sills. By this form of construction the body can not only be brought down, but the frame can be made as narrow as in the ordinary street car body. This form of truck enables the car to be utilized for both street and suburban service. It is also found in its latest form utilized under long open cars. It carries the motors in a satisfactory manner, guides readily, and answers nearly all the requirements of the service. But the question of what form of truck answers inter-urban service is one which every railway manager must study for himself. This becomes necessary because the conditions on different roads vary so much that there are scarcely two in the whole country upon which they are identical. The question of the amount of traffic and the headway at which it is desired to run cars involves a careful study. With heavy traffic and frequent stops, it is necessary to have low cars from which ingress and egress are easy. An extra step will increase the danger to passengers very much. On the other hand, where passengers are carried a considerable distance without stops, long cars with more than one step are permissible.

As inter-urban service is almost equivalent to that of the steam roads, for this service pivotal trucks having regular swing beams, equalizers, elliptic springs, and all the parts of the steam road truck are entirely satisfactory. They take curves easily at a high rate of speed. But for trucks which must run not only on trams, but on T rails, some form of the maximum traction truck will give, all things considered, the best service.

In conclusion let me call attention again to this very important question to be considered in connection with the adoption of single and double trucks, which is whether the punishment to the track by single trucks is not so great as to more than make up for the cost of putting in and running double trucks under cars of all lengths of bodies, whether short or long.

THE MODERN POWER HOUSE.—II.

BY R. MC CULLOCH.

STEAM CONSUMING APPARATUS.

THE question of the selection of the proper engine to operate the plant is so dependent upon what dynamo is to be used that it will be best to abandon our arbitrary classification temporarily and take up first the question of the dynamo. During the past four years the street railway generator has undergone a radical change. In the spring of 1893, there were installed in this city, in the power house of the Cass Avenue & Fair Grounds Railway Company, then being built, the first large direct driven generators of this type, which has since become so common. Soon after this the Intramural power house at the World's Fair was put in operation, containing one generator of the same size as those in St. Louis and another of twice the capacity. Since that time there have been few large power houses built in which direct driven generators have not been installed, and some of the large railway systems have found that economy of operation required a change from the belt, countershaft and unit of small size to the large direct driven generator. At the present time, the West End Railway Company, of Boston, which may be considered the pioneer in this country in electric traction, is changing its central power station, which had originally been equipped with a very complete and elaborate system of belting and countershafting, to a direct coupled plan.

The first cost of the direct coupled generator is about 35 per cent. more than the belted generator in the 500 k. w. size, which is the largest standard size in which the belted generator is made, but when the expense of the belt, belt tightening device and the floor space is taken into account, the direct connected generator will be found the cheaper. Besides obviating the necessity of the costly and cumbersome belt, the direct connected generator offers the following advantages: in large sizes and in conection with large engines it has a much higher efficiency than the belted unit, it requires a small floor space, it aids supervision by bringing the working parts of the engine and generator close together, it reduces danger, it is almost noiseless in operation, and it may be installed in a larger unit than the belt driven generator, which is limited in size by the width of the belt and pulley which may be employed. The main objection which was urged against the direct connected generator was the fact that the shocks resulting from overloads were thrown directly on the engine, and that there was none of the cushioning effect that a belt connection might supply. While this is undoubtedly true, the best argument which may be submitted against it is that none of the installations of direct driven generators can trace any trouble to this source. The large, slow speed, multipolar, direct driven generator has become, perhaps, the most prominent feature of the modern power house, and while there may be special services which would necessitate a belted arrangement, it is difficult to imagine a power house thoroughly up to date without direct driven generators.

By varying the number of poles and the number of armature conductors in the construction of a dynamo, the machine may be designed to run at almost any reasonable speed, the slower the speed, however, the greater being the cost of the dynamo. In the matter of speed it is necessary for the dynamo maker and the engine builder to effect some sort of a compromise, because it is not good practice to run such large engines at too high a speed. The speeds which are most common are 75 r. p. m. for the 1,500 k. w. dynamo, 80 to 120 r. p. m. for the 800 k. w. dynamo and speeds running from this to 150 r. p. m. for the smaller sizes. These speeds are what would have been considered, four years ago, quite out of the range of the Corliss valve gear, but the makers of this type of engine have risen to the occasion and now there are numbers of large Corliss engines driving generators at speeds up to 100 r. p. m. and some have even higher speeds than this. Several other types of engines have been adapted to this work and are running quite successfully. Outside of the question of valve gear, most engines made for this work possess the same characteristics; the heavy bedplate, the solidly constructed fly wheel, now being made of steel plate, the wide cross-head, the large connecting rod and the mammoth main bearings.

The choice between horizontal and upright engines is chiefly one of space. The horizontal engine is the cheaper, the simpler, the easier to inspect and the easier to repair. Outside of

the advantage of requiring less space, the upright engine has the advantage of less wear on the cylinder, and a more direct strain upon the foundations.

The usual practice in the most modern power houses is to install compound engines. Most of these plants are so favorably situated that condensers may be operated in connection with the engines. This is undoubtedly good practice, but in case condensers are not used the cost of fuel must be very high for the gain in compounding to pay for the extra investment. Where power houses are favorably situated on bodies of water, condensing becomes a very simple problem, but in case the power house cannot be built on a body of water, as in this city, for instance, in order to use condensing engines, some sort of arrangement must be designed to cool a quantity of water so that it may be used over and over again for the purpose of condensing the exhaust steam. Devices of this kind have long been in use in the city of San Francisco and in Cuba, and lately several of the large manufacturing companies have put on the market complete apparatus for the purpose of cooling water after it has condensed the exhaust steam so that it may be used again for the same purpose. Besides the gain in power by using condensing engines, it is claimed that by the use of this apparatus, actually less water is used than if the steam is exhausted directly into the atmosphere without condensing.

In the use of large direct connected units a great deal of the economy to be gained depends upon the selecting of the proper sizes of units. The efficiency of a generator will be good when it is operated at more than 75 per cent. of its capacity, but the efficiency of an engine drops off very rapidly when it is running below its rated load. In order to achieve the best economy from the use of large direct connected units, the sizes of the different generators should be so proportioned that it is always possible to operate one or more units at their rated capacity. The railway generator as at present built will stand an overload of 50 per cent. for several hours without trouble and at a maximum efficiency. This should be taken into account in the estimate of the dynamos required, but it should always be the aim to have at least one idle machine to throw on the line in case of failure of any of the others. The actual size of the units depends upon the character of travel which the road possesses and the number of cars, and this must be determined for each road independently. In choosing machines, however, standard sizes should always be adopted as this obviates any trouble in obtaining supplies and repair parts.

The railway generator switchboard has become standardized to the extent that it consists of a panel for each generator, each panel containing the usual automatic circuit breaker, ammeter, field rheostat, field switch and main switch. It is hardly necessary to mention that there should be nothing combustible about the board, and it is not an absolute necessity for the board to contain a marble tablet inscribed with the illustrious names of the president, vice-president and secretary. It would confer equal fame and perhaps be more economical of valuable space for their names to be handed down to posterity in some manner less electric. Switchboards as now erected usually contain a recording wattmeter and an ammeter which shows the total output of the power house. The recording wattmeter, especially, is a valuable instrument, as by means of its readings exact records of the power house may be kept.

The modern method of line construction is to divide the trolley into sections and connect each section separately to the main bus bars through feeder panels, each of which contains an automatic circuit breaker, an ammeter and a switch. This method confers the advantages that trouble on the line is always indicated on the proper section, and that in case of short circuits on the line, the main circuit breakers are protected by the section circuit breakers and the load is not suddenly thrown off the engines by the opening of the main circuit breakers. Most of the generator and feeder boards are supplied with devices for preventing damage to the station machinery by lightning, but a very simple and effective arrangement is to connect a large water rheostat between the positive bus bar and a good ground. This is either left in circuit continuously with a small current running through it, or is cut into circuit on the approach of a storm.

Besides those machines which are absolute necessities in a power house, there are various devices which may be added to secure convenience and regulation. An overhead crane is installed in the engine room of most of the large modern power houses and adds greatly to the speed with which heavy repairs may be executed. An oiling system of some sort by which the oil is either pumped or flows by gravity to the different bearings obviates the necessity of manual labor in oiling and insures a steady feed at each bearing. A recording steam gauge is found very useful in checking up the firemen. An air pressure system is beginning to be used in many of the power houses by means of which the carbon dust may be blown out of the armature windings. With this apparatus an armature may be kept thoroughly clean, and the danger lessened of short circuits occurring on account of the collection of carbon dust between its conductors.

HOW CAN THE REVENUE OF STREET RAILWAYS BE INCREASED?—II.

(Concluded.)

BY C. DENSMORE WYMAN.

WHATEVER clever and ingenious scheme may be devised and adopted by the street railway manager for making more attractive the service offered by the company and increasing its patronage, it will fail of its ultimate purpose unless with the growth of business so stimulated he shall exercise a like amount of skill and sagacity in the selection and training of employés upon whose honesty, faithfulness, intelligence and carefulness he can depend. Attractive resorts upon the route of a road may be opened and fostered; a general system of transfers offering great benefits to the patrons of the line may be introduced; new territory may be occupied; in many ways more travelers may be allured to the cars; still, if the fares so brought to the mands of the company's collectors are not honestly handled; if its motive power and the devices for its application are unintelligently and uneconomically managed; and if that measure of discipline which secures the safety of its patrons is not enforced, the increased gain will not be found to result in an increase of the coveted net results.

To state in full the various rules and methods adopted for the securing of the desired charactistics just mentioned on the part of the employés would take too much of our space, already so nearly exhausted. We have not room to speak of the many and various excellent schemes of rewards and prizes offered to their men by not a few companies for excellence in the matter of freedom from accidents, careful handling of the company's property and perfect reports, schemes which have proven most useful and with which it would be well for us all to become familiar.

We cannot, however, refrain in this connection from congratulating the street railroad companies upon the fact that a superior class of men have of late years sought employment at their hands. The motorman or gripman of to-day is the superior of his predecessor, the horse car driver. The conductor of the modern fast moving car with trolley to care for, transfers to issue and a more critical public to serve, must needs be brighter and more capable than his brother of the old style car. The chief engineer, the electricians, the master mechanics and the superintendent are necessarily men possessed of a better education and a far wider range of thought and information than were those whose duties were limited to the care of horses and stables, mule cars and flat rail tracks in former days. As our business has grown in its technical and scientific requirements it is attracting a class of men for whom before there was neither call nor inducement to enter its service.

These facts are to be considered in the selection of our employés. A regular mental and physical examination should precede the appointment of all trainmen, and in the mechanical departments only skilled men, exclusive perhaps of apprentices ought to be engaged. Every effort should be made by the manager and his assistants to enlist the interest and promote the education of the employé as regards his duties and the general characteristics of the business. While it is true that sometimes "A little knowledge is a dangerous thing," we cannot sympathize with that policy which would make of the workman merely an automaton. The rule which some roads have of requiring their motormen to spend a certain time in the repair shops before they take their places on the cars is one worthy of imitation, and various other methods adopted along a similar line of education are to be commended. But with the desire on the part of the manager to educate the faithful men in the ranks must be a determination to prevent the retention or engagement of the dishonest, the intemperate or worthless.

We venture to make a suggestion which may aid in the line of this perhaps. Let it be a general rule of street railroad companies that all conductors, motormen or gripmen must, before entering the service, procure a bond from a reputable guaranty company. For motormen, this bond would be in the nature of protection against damage to property, in the case of the conductor, damage to property and dishonesty. The company selected for the giving of such bonds should be one having agencies in all of the principal cities and towns of the country.

The modus operandi of the bonding would be as follows: The man seeking either of the positions named, would make application in written form with a statement of names of former

employers and their location, and would then be informed that such application would be sent to the guaranty company, and if accepted by them as a good risk, other conditions having been complied with, his appointment would be made. The guaranty company would then in accordance with their usual business methods make inquiry of the reference given, as to the applicant's record, and aside from this, examine all records in their several offices in the various cities to ascertain whether the said applicant had ever been the cause of a loss to them upon any former railroad or other position. With this system in whatever other city the wrongdoer might apply, his second attempt would be likely to be frustrated. The peripatetic fraud would be caught, while the knowledge on the part of those once accepted that if through carelessness or dishonesty their bonds would be forfeited and the record of such a fact placed on the books of the guaranty company would ever prevent another bonding and thus disbar them from the obtaining of another position of trust, would certainly prove a valuable deterrent to initial wrong.

If the street railway companies could but unite in this matter a responsible guaranty company would no doubt be found who would undertake the work as outlined above, and the cost to employés for such bonds could by arrangement be made inconsiderable. The assurance that the records of applicants would be carefully searched and their subsequent actions carefully noted and recorded would certainly serve to discourage bad men from applying, and restrain others holding such position of trust as that of trainmen from yielding to temptation and going wrong.

The methods of an army-like discipline to effect the discovery of offenses and the prompt discharge of the offender, the setting about the camp of guards and pickets beyond which no one may pass, is necessary and effective, but after the practice of many successful military commanders, who, when the battle was set, were accustomed to ride in front of the rank and file of the army, and with words of encouragement and cheer stimulate to deeds of daring and devotion, so may not we with success adopt some method of coming into personal contact with our men, not as stern judges, presiding simply at their trial and prepared to deliver sentence, but leaders, educators and fellow-workmen in the business in which we are engaged. In the case of a smaller company this might be accomplished with comparatively little trouble by the manager or superintendent, making it a point to frequently meet his employés, either in a group, say, at the stations where there are several connected with the system or en masse at some meeting held for the purpose. Thus instead of always presenting himself as a taskmaster, he will be able freely to discuss with them the necessities of the business and the purposes of the company with especial reference to their individual welfare, and he will have the opportunity to bring before them items of general information touching latest developments in the technique of street railroad work. In this way he and his men will be en rapport and more cordial relations will be established between them.

Where a company consists of a large number of lines, requiring the employment of many men and the division of official work among a number of officers, it becomes a question as to the best method to be adopted by the officers for making themselves known to the individual employé other than by the usual style of written orders, promulgated from time to time, and posted in the stations and shops. Having felt the desirability of some other and pleasanter medium of communication with his employés, the writer of this paper about a year ago began the monthly publication of a little sheet entitled "Milwaukee Street Railway Bulletin," and its objects were set forth in a short editorial in the first issue to the effect that the publication was issued in the hope that by it might be effected a closer relationship between the management and the employés, based on a more definite understanding on the part of the latter, of the wishes and intentions of the former. It was also announced that as from time to time changes in the method of running the cars, the use of material and the general operations on the road, in the shops and power plant, might be deemed best by the management, either to test or permanently adopt as the company desire, in order to avail itself of the experience of other companies in their work, when after due investigation such experience seemed to offer something desirable for adoption; and as the usual form of such changes, as far as the employés were concerned, came to them in the shape of some new rule or regulation to be obeyed in most cases without a clear and definite idea of the cause of such ruling; it was proposed by means of the Bulletin to set forth from time to time the reasons for changes made, so that the desires of the company might be thoroughly understood and unity of purpose on the part of both official and employé thus promoted.

It was further set forth that it was the intention of the management to publish from time to time facts and news concerning the business that would be interesting and educating to readers, the results of improvements made on their own and other roads, of the construction and operation of electrical roads, details of which would be usually published in a trade journal, and, perhaps, would not always be accessible to those to whom the paper in question was to be sent.

Following the line marked out for such publication, the little paper was issued each month for more than a year, and in each number suggestions, requirements, rules, timetables, etc., were set forth for the benefit of the employés. Articles on the best means of handling transfers, the care of street railway motors, the treatment of passengers, and particularly the troublesome ones, statistics of the operation of the road and electrical information in general were put in print and placed in the hands of every employé. A personal column was also introduced, in which mention was made of any act showing skill in the avoidance of accidents, in the handling of the motor, etc., and attention was called from time to time to deeds worthy of commendation. To the columns of the Bulletin contributions were invited from the heads of the different departments, and in a column called Reminders, short articles were introduced, calling attention to any laxity on the part of the men in reference to any particular rule, together with suggestions how to act under any especial combination of circumstances. To its columns were welcomed contributions from the men, and queries addressed to the management by employés were answered in its monthly issues.

The publication of the little sheet was in the nature of an experiment, but the fact was speedily developed that the paper was of great utility. Its monthly issues were looked for by the employés, and its suggestions were made matters of discussion at the different stations and gathering places of the men. Hardly a conductor or motorman on the road did not carry his copy with him and often referred to it. The four page sheet soon changed to one of eight pages, 8 inches x 12 inches in size, and a few advertisements judiciously selected paid the expense of printing and distribution.

While the preparation and publication of such a paper will necessarily add to the burden of duty, already sufficiently great in the case of most managers, its value in keeping the men of the line in close touch with their officers by disseminating information of local value in the daily operation of the road, and in stimulating to better efforts by a judicious admixture in its columns of praise and blame and suggestions to those the labor involved in its production. We would recommend to whom it is addressed, will make it worth many times over, a trial by all street railway companies of some such printed sheet for distribution among their employés.

Some companies have fostered what might be termed a benevolent protective society among their men, the officers of the company being included in the scope of such an organization with a voice in its affairs. We regard such societies as valuable along the lines of which we are speaking, and if tact and skill is used in the official relationship of the company to such a club or association, it can be made the medium of the cultivation of pleasant relations between the employer and the employed.

Reading rooms at the different stations and shops provided with technical journals, as well as the daily papers, for the use of trainmen and others can be made most serviceable; and all these methods tend, we believe, to the retention of good men, the cultivation of good principles on the part of the employés, and naturally the elimination of the bad, the worthless and the ignorant. Given a large proportion of honest and intelligent employés upon a road, and by a natural process of the pressure which good always exercises upon evil, the bad will find themselves out of place and will be forced to leave. The work of the detective bureau, important as it is, ought, we believe, at all times to be supplemented by the most liberal efforts on the part of the managers to impress upon their employés, either orally or in printed form the advantages of doing right, the benefits of an intelligent conception of the scientific facts with which in their daily work they are constantly dealing, and the cultivation of an enlightened public sentiment among them, to the end that the dissipated, the ignorant, the careless and the dishonest may be made ashamed, and of their own accord seek other positions more congenial to their tastes. Light dissipates darkness.

AN ELECTRIC ROAD FOR HAYTI, WEST INDIES.

The Berlin Iron Bridge Compnay, of East Berlin, Conn., have a contract for a car barn and shop building for an electric road at Port au Prince, Hayti. These buildings will be of steel throughout, having a steel skeleton framework covered on the sides and roof with corrugated iron. The shop is 33 ft. by 70 ft., and the car barn 40 ft. by 160 ft.. This building is

only one of many which have been gotten out by this same company for export to foreign countries during the past few months.

THE ELECTRIC EQUIPMENT OF BROOKLYN BRIDGE CARS.

THE switching of the Brooklyn Bridge cars by electricity will shortly become an accomplished fact. The cars are being rapidly finished, and as they reach the yards of the Brooklyn Bridge Railroad, will be fitted as fast as possible with the electric apparatus. The twenty car equipments forming the order are now ready in the shops of the General Electric Company, waiting for the cars to reach Brooklyn.

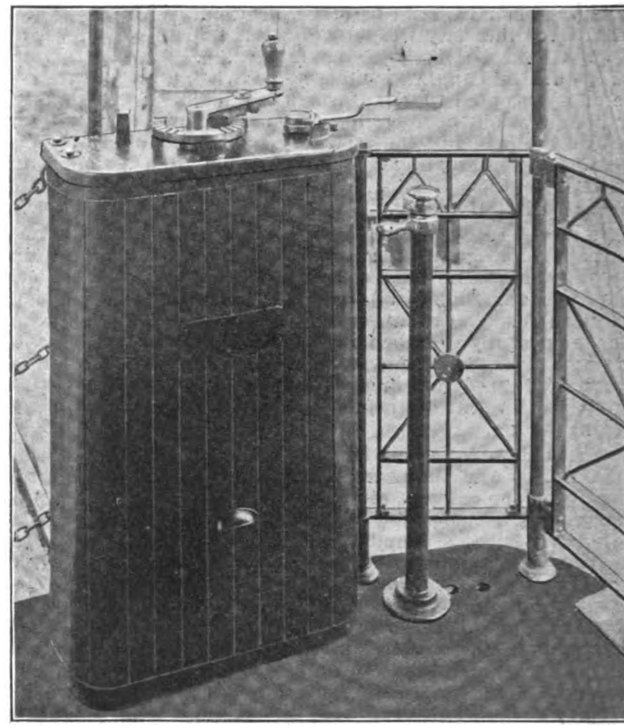
The first car, a handsome piece of car work, reached Schenectady from the shops of the Pullman Palace Car Company a few weeks ago, was fitted with the electrical apparatus, and is now in Brooklyn. The remainder of the cars will be equipped at their destination. The electrical equipment of each car consists of four G. E. 50 motors and two K. 14 controllers, both especially designed for this work. The motors are completely encased, and are water tight and dust tight. The armatures are slotted, each coil lying in its own slot, and the method of winding followed allows of the removal of any coil with very little disturbance to the others. Each motor is provided with a roller which will come directly over the cable and prevent it from abrading the motor or injuring it in any way and from being injured itself.

The K 14 controller is the standard K-type of controller adapted for four motors of the capacity of those which will be used in this case. It embodies all the qualities of the K-type, and, of course, has the magnetic blow-out. Two circuit breakers, a magnetic fuse box and twelve resistances complete the electrical motive equipment.

The only portion of the electrical apparatus which will be plainly in sight, will be the controllers at the extreme edge of the platform and an upright iron post with a small handle to operate the circuit breakers. Motors, resistances, circuit breakers, etc., will all be out of sight beneath the car. The circuit breakers are closed and opened from the platform, but are so placed that inspection can readily be carried out.

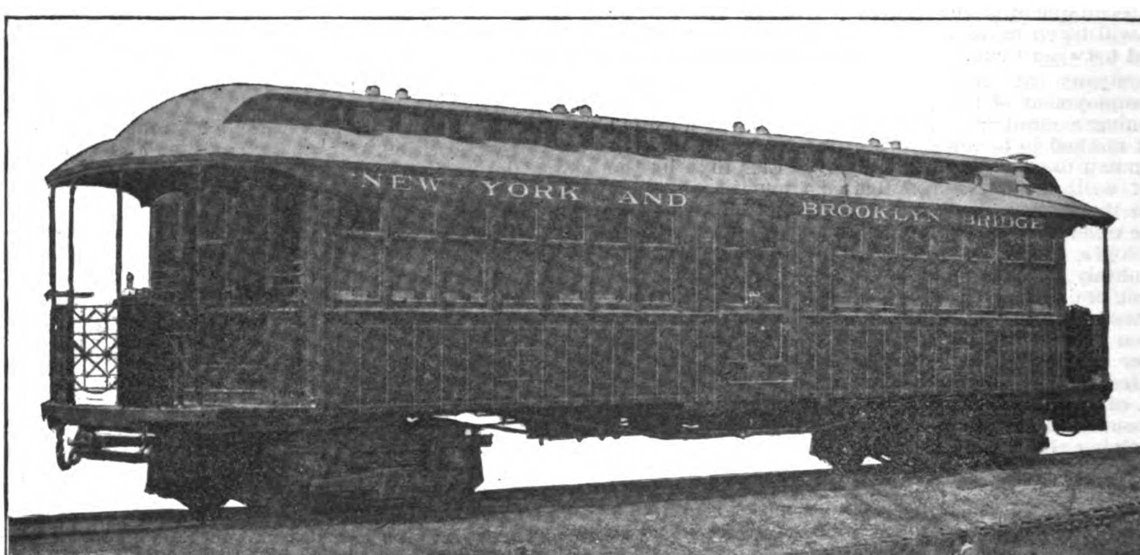
The duty which these motors will be called upon to perform will be to switch the four-car trains from the incoming to the outgoing platforms. When the trains are loaded the motors will push them forward over the tilting sheaves, where the cable will be taken up by the grips on the other three cars of the train. The conditions of the contract between the electrical company and the Brooklyn Bridge trustees, require that in case of any failure on the part of the cable plant the four motors together shall be powerful enough to propel the fully loaded train weighing 120 tons across the bridge at the speed of the cable, i. e., 11.3 miles per hour. The capacity of the motors is such that they will be able to haul the heaviest bridge trains up a 3.78 per cent. grade not only for the short thousand feet—the length of that grade on the bridge structure—but the whole length of Manhattan Island, if necessary. The trucks of the new cars are from the shops of the McGuire Manufacturing Compnay, which has recently constructed the trucks of the electric cars used on the Lake street elevated in Chicago.

The third rail method of contact will be adopted, and current will be taken by four shoes to each motor car, two on each side. These are suspended from a support set between the journal boxes of each truck, and will be so hung as to give a perfect contact with the third rail.



FRONT PLATFORM, BRIDGE CAR, SHOWING CONTROLLER.

As soon as the full number of motor cars is equipped and in service, the steam locomotives will be taken off. This will not only mean a relief to the passengers on the trains, but an actual source of economy to the bridge itself, the gases from the locomotives proving an actively destructive agent to the ironwork of the terminal stations.



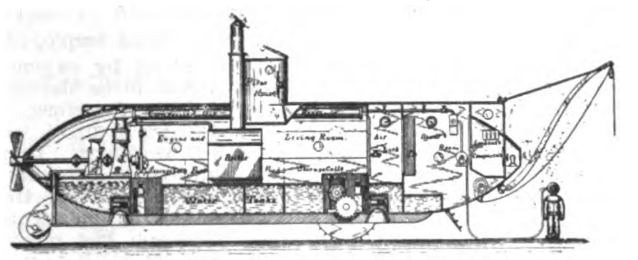
ELECTRIC MOTOR CAR, BROOKLYN BRIDGE.

The question of the abandonment of the cable for the complete operation of the bridge trains by electricity is one which will probably be settled in favor of the cable. The uniform speed given to the cars by the cable, and the fact that the

cars, while attached to it, are spaced at regular intervals, eliminate from the operation of the trains a personal factor, which might tend to accident, while by balancing up grade trains against those running down grade, the consumption of power is reduced to a minimum.

THE LAKE SUBMARINE BOAT.

A CURIOUS and interesting form of submarine boat has recently been devised and built by Mr. Simon Lake, of the Lake Submarine Company, of Baltimore. Experiments already made off the coast of New Jersey, under water, in leaving and returning to the boat while submerged, have encouraged Mr. Lake in the construction of another similar craft of more powerful character. The cut herewith gives a general idea of the boat, which is mounted on wheels or rollers and might be designated a submarine wrecking boat. The plans call for a compound steam engine of approximately 70 horse-power; the motor will be 10 horse-power for driving the wheels, and the generator can also be used as a motor for driving the propeller when the boat is traveling wholly submerged. Mr. Lake informs us that in his original experiments, it was demonstrated that the direct propulsion by the driving wheels on the bed of the sea was much more economical of power than the use of the screw. The dynamo is of 18 kilo-



LAKE SUBMARINE WRECKING BOAT.—SECTION.

watt capacity and charges batteries which consist of 60 chloride cells, type G, 13 plates, made by the Electric Storage Battrey Company, of Philadelphia.

The estimated speed of this strange craft when running on the surface is about 8 miles; and when submerged, about 5 miles. The air supply has been designed to be of sufficient capacity to allow a crew of 6 men to stay on the bottom 48 hours, if necessary. This air is compressed in steel tanks 14 inches in diameter to about 70 atmospheres. The other machinery consists of an air compressor capable of compressing 3,000 cubic feet of free air per hour at 1,000 pounds to the square inch. Provision is also made for a steam, hand and electric pump, for manipulating the water ballast, a foul air pump, and an electric hoist. The traveling endurance of the boat, in service, and when running on the surface is estimated at about 1,200 miles, and when submerged, one charge of the battery is estimated to take care of it for 60 miles at slow speed. The displacement of the boat submerged is about 100 tons. Mr. Lake considers that in wrecking operations, in pier building, recovery of sunken treasure and cargo, and in naval warfare, such a boat has a large and profitable field of usefulness.

PRESIDENT VREELAND PREFERS THE TROLLEY.

WHILE traveling in the West recently, President H. H. Vreeland, of the Metropolitan Traction Company, of New York City, was interviewed at Denver as to street railway conditions and methods. Among other interesting things, he said: "I do not think there is any known system of railroad propulsion, that can compete with the trolley. The press and the public have declared themselves against the trolley, and it has become necessary, by reason of the conditions that surround us, to experiment with some new system to take the place of the overhead wire, which we cannot use, and the cable, which is almost impracticable on account of the irregularity of the streets of New York City. We have been making experiments with a system of our own, which is known as the Hoadley-Knight compressed air system and matters have advanced to that stage where we have been able to make some practical demonstrations of the efficiency of this new system.

"The growth of our business in the past two years has been very large, our roads having carried 45,000,000 more passengers in that period than at any time since the organization of the system. Of course many of the passengers carried by our roads have been taken from the elevated roads owing to the superior facilities given by surface roads through the liberal system of transfers to connecting lines. As an evidence of the popularity of the transfer system note that the average number of persons transferred by our lines is 150,000 daily and for the last fiscal year over 45,000,000 persons were transferred on our lines, representing a business of over $2,000,000. The different lines operated by the companies which I represent employ over 8,000 men and of the 188 miles of trackage but 38 miles are operated by mechanical traction, while on the rest we still employ horses and keep constantly at work more than 8,000 of these animals. The New York system of railways is the greatest in the world, but owing to the many obstacles met with in the construction of mechanically operated roads we have been necessarily slow in equipping our lines with other than horse power. The trolley is by far the most practical and serviceable system we have and of the 14,000 miles of mechanical traction roads in this country 12,000 miles are equipped with the trolley. A very surprising thing to people in the West is the volume of business done by the railroads in New York City. On our Broadway line we operate 400 cars and have 17 miles of tracks on that and connecting lines and during each day of the year we carry over 300,000 passengers. On our whole system, which includes 150 miles of cable, electric and horse roads our daily average of passengers exceeds 700,000. The large increase in the number of passengers carried by our roads does not necessarily indicate a like increase in the business of the various roads of New York, for many of the passengers now carried by our lines were formerly accommodated by the elevated roads; but the standard of surface roads has approached in speed that of the elevated and surpassed it in facilities for reaching different parts of the city."

SHUNT MOTORS FOR ELECTRIC RAILWAY WORK.

IN some of the electric railroads recently installed in Europe by Messrs. Siemens & Halske, of Berlin, in hilly regions, they have employed shunt motors, contrary to the usual railway practice, in which series machines are employed. The principal advantage claimed for the shunt motor arrangement is the return of the current to the line, which is readily and safely accomplished by a proper arrangement of the apparatus. If the car is on a grade such that it maintains its speed without taking current, or rather if the car is able to produce electrical energy, then when the normal speed is attained the surplus work is not used to increase the speed, but is immediately taken up by the motors which then operate as dynamos, and return the current to the line. The accompanying diagram illustrates graphically what percentage of the current required on the up-grade trip by one car is theoretically

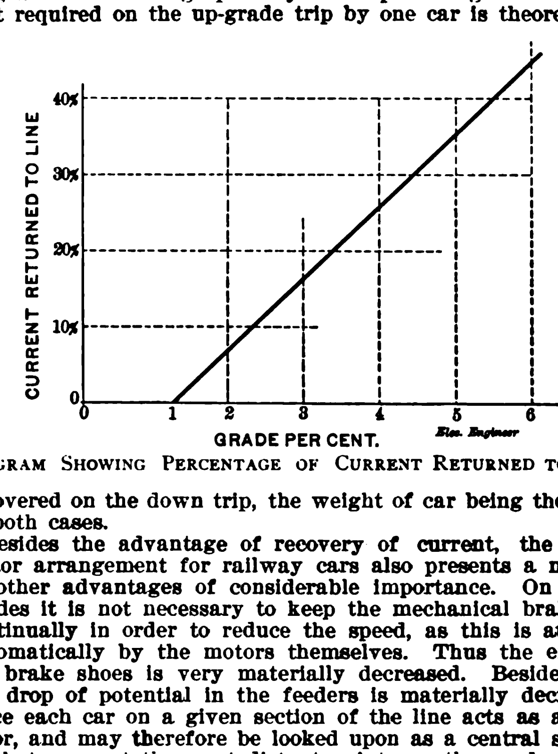


DIAGRAM SHOWING PERCENTAGE OF CURRENT RETURNED TO LINE.

recovered on the down trip, the weight of car being the same in both cases.

Besides the advantage of recovery of current, the shunt motor arrangement for railway cars also presents a number of other advantages of considerable importance. On heavy grades it is not necessary to keep the mechanical brakes on continually in order to reduce the speed, as this is attained automatically by the motors themselves. Thus the expense for brake shoes is very materially decreased. Besides this, the drop of potential in the feeders is materially decreased, since each car on a given section of the line acts as a generator, and may therefore be looked upon as a central station, so that even at the most distant points on the road, according to the contour of the country, the speed of the cars is less injuriously effected by the drop in potential. In consequence of this decreased drop the cross sections of the feeders may also be diminished, and hence the amount of investment decreased.

It follows also that the size of a central railway power station can be smaller for shunt motors, in the ratio of the current recovered.

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CONTENTS.

M. MOISSAN'S LECTURE.

THOSE who were privileged to hear M. Moissan's lecture on "The Electric Furnace," will long carry with them the memory of a delightful evening. In the logical arrangement of facts, the brilliancy of the experiments and the elegance of delivery, last Tuesday's lecture was a masterpiece and our brief account of it on another page can give but a faint idea of the charm which the lecturer diffused over the entire subject. But aside from the intellectual treat afforded M. Moissan's listeners, none could have departed without the strongest impressment of the fact that in the electric furnace the electrical engineer, the metallurgist and the chemist had at hand a most potent tool, the limits of whose usefulness no man could now foretell. The manufacture of carbides for the production of acetylene for illuminating purposes is but one and we think a comparatively small part of the work in hand, for we believe that the electric light will maintain its ground in spite of all opposition. Rather do we look for the greatest expansion in the employment of acetylene to obtain some of the most important alimentary products consisting of hydrocarbons, which have heretofore been produced in nature's laboratory only. The innumerable hydrocarbons employed in the arts, many of which are now obtained by expensive processes, may also in many cases be found to be derivable from this protean gas. In this field alone, therefore, the product of the electric furnace may furnish fruitful work for a hundred investigators and countless workmen. In the domain of metallurgy the aluminum industry is an example of what can be accomplished in comparatively short time; and if to this we add the manufacture of carborundum, and of graphite, the latter of which Mr. Acheson has recently accomplished successfully on a commercial scale, it requires no great discernment to recognize the direction in which the next important advance in electrical work may be looked for. If no other signs were at hand the increasing number of patents granted on electric furnaces and their products would of itself show that the opportunities here latent are being seized and turned to good account. We know of no more encouraging field to-day than the electric furnace, for the exercise of inventive genius, and expect indeed that it will at no very distant day rank with the most important applications of the current commercially as well as scientifically.

NEW YORK'S FIRE TELEGRAPH.

VALUABLE property is piled up in New York City to an extent and an amount hardly equaled anywhere else in the world. Owing to the nature of many of the buildings in a city that frequently changes its distribution of trades and population, and owing also to the methods of heating and lighting employed in the winter, the fire risk is abnormally large. Hence it follows that the service for fire alarm and suppression cannot be too good, and that any defect cannot be too quickly corrected. The superintendent of the Fire Alarm Telegraphs in New York City has recently been on trial for fraud and incompetency, and much evidence of an interesting nature has been elicited; but the Board has now closed the case and reinstated the impeached official.

We confess our pleasure at finding Mr. Smith continued in office and our belief that the shortcomings in his department have been due largely to the existence there of Tammany ideals and principles. Mr. Smith has not been a political hack in the sense of going in and out with any party, but we all know what Tammany control of the city meant, and what a man had to submit to in the discharge of technical duties. But that is at an end, and Mr. Smith, both for his own sake and that of this great city, must set his house in order. The evidence as to the condition of the fire circuits and boxes, given by Mr. Carty and Capt. Brophy, men of high repute and standing, betrayed a serious and deplorable lack of efficiency, and this regardless of any special form of apparatus or mechanism. Vigilance will often make poor apparatus work well; but a service run slackly will break down even with the best material and supplies. We trust that in view of the political conditions which now promise the city a purified administration of public affairs for many years to come, Mr. Smith will be able to bring his department into harmonious relation with the better state of affairs generally and will keep it free from all suspicion of improper management.

STREET LIGHTING IN ST. LOUIS.

ONE of the most important changes in methods of street lighting is that proposed for the city of St. Louis, where it is the present intention to abandon arc lights, on the next renewal of the lighting contract, and adopt incandescent lamps instead, the unit being 32 c. p.. This seems to us a retrograde step, and altogether unnecessary. If there is one thing the arc lamp has done it is to prove its superiority as a means of street illumination, whereas we do not know of a single instance in which the incandescent lamp has succeeded in giving satisfaction for city streets. Mr. Edison devised his special "municipal" system for such work, but it has not met with acceptance, although it had many features of merit. In St. Louis the old Heisler system of incandescent lighting outdoors has been well tried, but one does not hear of its popularity there or anywhere else. At one time it looked as though big incandescents of the "Mogul" type might come into vogue for street work, but they have not done so, and the arc has remained in possession of the field. We should greatly like to know the grounds, if there are any, upon which it is intended to make this important change, and would suggest that a better plan would be to improve the arc service up to the fullest extent.

DYNAMOMETER CARS ON STREET RAILWAYS.

THAT most annoying of the many troubles which beset the street railway manager, the track, its construction and maintenance, was well taken in hand in the report of Mr. Bowen, to the American Street Railway Association. How much a company can afford to spend upon its track, is a point on which most railway companies have always been in darkness. While they have a fairly accurate means of ascertaining the cost of haulage per car mile, they are, with perhaps a few exceptions, absolutely without any means of ascertaining the difference between the cost over a good track and that over a poor one, and when repairs are made they are, as a rule, undertaken when further neglect would be palpably ruinous to rolling stock and intolerable to passengers. The use of the dynamometer car as a guide in this case needs no recommendation, and the good work accomplished by it in Chicago is but a repetition of similar benefits obtained by its use in steam railroad work. There are many roads in the United States on which cars of this nature ought to be a permanent part of the equipment, and the sooner they are put in operation the better. For such roads whose limited mileage would make an investment in a dynamometer car of problematic value we would suggest a pooling of issues and a joint ownership with the car employed in rotation on the roads forming the pool. We believe also that an enterprising individual might find it a good investment to equip a dynamometer car and undertake to furnish street railway companies with detailed reports on the condition of their tracks, based on the indications of the car.

TWO THOUSAND ELECTRICIANS IN LINE FOR NATIONAL HONOR AND SOUND MONEY.

SATURDAY, Oct. 31, was not only "Flag Day," but was celebrated in many parts of the Union by large parades in favor of "sound money." The most striking of all these demonstrations was that in New York City, where 103,000 men turned out in line and were reviewed at Madison Square by Gen. Horace Porter, Grand Marshal, Gov. Morton, Mayor Strong, ex-Mayor Hewitt, and others. The route was from the Battery to the reservoir at Bryant Park and Forty-second street, following Broadway, Fifth avenue, and Madison avenue. The whole city was en fête, and was decked in the national colors, every building on Broadway being ablaze with the Stars and Stripes.

About eight or ten days ago, the Electrical Sound Money Club sprang into being spontaneously, with the purpose of participation. It was expected that about 600 might muster and a space was allotted in the Metal Trades Division. But the accessions were so numerous and rapid that some other arrangement became desirable, and in consequence a separate division was made, with Gen. C. H. Barney, of the New York Telephone Company, as Marshal. Headquarters were established in a store at Liberty and Greenwich streets, where a register was opened and a large supply of campaign flags and badges laid in. At 2.40 p. m. on Saturday, the division was ready and reached Broadway and Cortlandt street, where it fell in behind the Goldsmiths and Jewelers' division. The organization was as follows: Brig. Gen. C. H. Barney, Marshal of electrical brigade; Marshal's staff; G. F. Porter, Adjt. Gen. and Chief of Staff; D. C. Cox, Brig. Quartermaster; W. J. Sefton, Commissary; C. O. Baker, Jr., Medical Director; E. P. Decker, Engineer; T. C. Martin, Judge Advocate. Aides-de-camp, F. S. Blackall, C. P. Geddes, C. R. Vincent, E. T. Rice, P. A. Ferry, A. A. Knudson. These were followed by officers of the club as follows: President. E. S. Greeley; vice-presidents,U. N. Bethell, Chas. Blizard, A. L. Salt; secretary, S. L. Coles; treasurer, W. L. Candee. Then came the huge club banner borne by three men, and behind this, having the right of line was the First Regiment, the Crocker-Wheeler Regiment. It followed a fine brass band and consisted of the Ampere Electrical Club, under the command of Dr. S. S. Wheeler, whose staff and aides were F. J. Sprague, G. S. Dunn, F. M. Pedersen, F. M. Jeffrey, W. M. Aikman. It marched like a body of veterans and was splendidly handled. The men took part with the utmost enthusiasm and the Crocker-Wheeler Company ran for them a special train from the works to the city. The number of men in line in this superb regiment under Col. Wheeler's orders was not far from 500, as the regiment included also a strong contingent from the Sprague Electric Elevator Works.

The Second (Telephone) Regiment, headed by a drum corps, was under command of Col. F. M. Anderson and included 250 employés of the N. Y. Telephone Company; Southern Bell Telephone Company; American Tel. & Tel. Company; Consol. Tel. and Elec. Subway Company; Safety Ins. Wire and Cable Company (110 men), Capt. A. D. Eckert; Western Union Tel. Company (50), Capt. H. R. McKenzie. Then came a brass band at the head of the Third (Interior Conduit and Ins. Company's) Regiment, Col. C. L. Pease, employés of that company, 250, Capt. Vandewater; The E. S. Greeley & Company (75), Capt. R. A. Morrison; the Okonite Company; White-Crosby Company; Tucker Elec. Cons. Company; Diehl & Company; Elec. Storage Battery Company; Conduit Wiring Company, Electrical Eng. and Supply Company; The Electrical Engineer, and scattering. This was followed by the Fourth (Western Electric) Regiment, Col. C. F. Nichols; employés of the Western Electric Company (350); Phœnix Interior Telephone Company; Martin Commercial Electric Company; and scattering. This regiment had the famous Rankin Drum Corps, which went through all manner of clever evolutions, eliciting thunderous applause all along the line.

Altogether the Electrical Division showed up with 1,830 paraders, who presented a most creditable appearance and marched splendidly, eliciting special newspaper praise on this score. All carried gold badges of the club on their coats, as well as other special devices, and a great many wore golden chrysanthemums. All political parties were represented in this parade for sound money, and not only were the men from the bench of the electrical shops and pole lines there, but experts and inventors of international reputation. It was a display of patriotism that made the blood tingle, and the parade will certainly never be forgotten by its participants.

The Electrical Brigade, under Gen. Barney's special instructions, followed the latest U. S. Army drill regulations and marched past the reviewing stand with flag canes at "port arms." No others as far as observed did this, and it certainly caught the fancy of the vast crowd. The Brigade extended a quarter of a mile in serried ranks, 16 abreast.

The Interior Conduit men carried canes of gold made from shining brass armored conduit, and wore special badges. The Greeley employés had incandescent lamps at the ends of their canes. Gen. Barney, who wore a blue gold fringed sash and carried the handsome gold headed cane presented to him as superintendent of the Electric Launch Fleet at the World's Fair, did wonders with his cohorts and was heartily congratulated by everybody. He has issued special orders felicitating the Brigade on its fine showing and its success.

TELEPHONY AND TELEGRAPHY.

ELECTION RETURNS BY TELEPHONE AND TELEGRAPH.

GREAT preparations have been made all over the country for sending election returns by telephone and telegraph, and by this time most if not all of our readers in this country will have availed themselves of the service in some form or another.

In New York City and Brooklyn the Western Union Company is sending to probably 250 places the election returns received at the main office. The Postal people have a large number of engagements of the same kind, and both companies have done their utmost to get the earliest information of the issue of the election. Every important news center in the country has been covered, and the operators in all the cities and large towns have been cautioned to exert themselves election night as never before.

The Union League, Manhattan, Century, University, Calumet, Catholic, City, Colonial, West End, Democratic, Grolier, Press, Hardware, Harlem, Lambs, Lawyers, Lotos, Merchants, New York, New York Athletic, Republican, Reform, Seventh Regiment Veteran, United Service and other social clubs all have received returns. Most of these clubs have secured special wires and special operators. As fast as the returns were received they were read to the club members and invited guests.

There are thirty-five Assembly districts in this city, and in nearly all of the district headquarters operators were stationed who got the election bulletins as fast as sent into the main offices of the two big telegraph companies.

It is estimated by the telegraph companies that the number of special wires and operators contracted for is at least double the number used four years ago. All of the theatres have made arrangements for the receipt of the news, and the important bulletins were read from the stage during the progress of the performances.

Of course there were great crowds about all the newspaper offices. The display of bulletins has been made upon a scale never before attempted. Correspondents in all parts of the country have been notified to remain on duty all night and to make free use of both the telegraph and telephone wires. The amount of money spent by the newspapers in collecting the news is something fabulous, but the intensity of the popular interest in the election justifies the outlay.

Not less than 100 private citizens have made contracts with the telegraph companies for running special wires into their homes.

The Long Distance Telephone Company gave its news gratis to all subscribers. The officials of the company say that the election has furnished them with an opportunity to demonstrate that the telephone is something more than a local convenience. It happens that the Long Distance Company covers all of the States in which the fight has been the fiercest. Illinois, Indiana, Missouri, Wisconsin, Michigan, Kentucky, Tennessee—in fact, all of the States east of the Mississippi River—contain a network of long distance wires, centering in cities in which the greatest work of the campaign has been done.

Gen. Hanna, chairman of the Republican General Committee, had a direct wire from New York to Cleveland and another from Chicago, so that he could be in his office with a head piece and hear the news. Mr. Hobart had a direct wire into his house at Paterson, and the Long Distance Company kept him informed. From New York to Canton stretches a wire which ended at a desk in Major McKinley's house. As fast as the news was received at this end the secretary who had the headpiece in place in the McKinley home heard it and repeated it to the next President and his friends and neighbors.

The long distance telephone has 200 subscribers in this city. For the most part they are brokers, bankers and big merchants. The company requested all of them to be in their offices on election night. Expert operators were furnished by the company, and as fast as news came in from all the cities in the middle West and from other places it was read aloud to those in the offices.

There are 15,600 telephones in this city operated by the New York Telephone Company. Although the company thought of a scheme of giving the election news to all of its subscribers, it was found impossible to so arrange matters. The company, however, gave out the returns at all of its main stations, and special plans were made for the hotels. The local company got its bulletins from the long distance people. The latter also covered Police Headquarters in this city, a force of experts being there to tabulate the returns and get them in shape for transmission over the wires.

Special arrangements were made for telephonic election news by the New York Athletic, Manhattan and Fairfield Golf clubs. The latter is at Greenwich, Conn. Local and long distance telephones have been in use at the Republican National Headquarters in the Metropolitan Life Insurance Building, the headquarters of St. John and the Popocratic State Committee in the Bartholdi and the Republican State and County committee in the Fifth Avenue Hotel. The sound money democratic headquarters is in East Twenty-third street. Tammany Hall and the St. Cloud headquarters of the anti-Tammany Democracy also have had the local and long distance telephone service in addition to the usual telegraph facilities.

At the Bartholdi, Hoffman, Gilsey, Windsor, Majestic, Holland, New Netherlands, Plaza and other hotels every effort has been made by both the telephone and telegraph companies to give all the news of the election.

THE SUBMARINE CABLE MEMORIAL.

The proposal in England to create a memorial to the original promoters of submarine telegraphy, and the selection of the names of Sir John Pender, Sir James Anderson, and Cyrus Field for special honor, has provoked speedy and vigorous protest. Capt. Henry A. Moriarty, a distinguished officer of the Royal Navy, hastens to point out that Sir James Anderson's only connection with submarine telegraphy, from the technical pioneer point of view, was as captain of the merchant ship Great Eastern when engaged in the laying of the second and third Atlantic cables, while Sir Charles Bright and Sir Samuel Canning were the responsible persons, as regards the various early Atlantic cable expeditions of 1857, 1858, 1865, and 1866. Lord Kelvin, he says, is a sufficient witness on this point. Mr. Henry Clifford, who acted as assistant engineer both to Sir Charles Bright and Sir Samuel Canning, also writes to the London newspapers to explain that no small amount of the credit is due to Capt. Moriarty himself, who was especially selected by the Admiralty to act as navigator with both cable expeditions. At the same time he admits that the indomitable energy and perseverance of Mr. Field, as a commercial man, in raising the capital and pushing the enterprise, are entitled, undoubtedly, to admiring recognition, as are the efforts of Sir John Pender in a similar direction in England.

A TELEGRAPH LINE AMONG THE ARIZONA INDIANS.

Part of the new plan for prevention of raids by the Apaches includes the construction of a military telegraph line in Arizona, to be built by the Signal Service Corps.

A single line of wire supported on iron telegraph poles, will comprise the proposed work. The material to be used, now on its way to Bisbee, is what is left of the old military line between Carthage, N. M., and Ft. Stanton, N. M., a distance of 90 miles. Part of this material was used to erect the line put up some time ago between Cedar Springs and Mammoth, Ariz. The Indians rarely resort to cutting of telegraph wires and consequently the only danger to lines is the destruction of the poles and insulators. Campers and overland travelers in that country where wood is so scarce might be tempted to cut down the wooden poles for use in burning. Consequently iron poles will be employed. It has always been a favorite diversion of humorously inclined cowboys to try their marksmanship by shooting down the glass insulators. There is an act of Congress which makes this sport an offense against the Federal government, and Capt. W. A. Glassford, U. S. A., will attach to his iron telegraph poles linen notices of the law in regard to insulators, the same to be printed in both English and Spanish so that everyone who runs, or shoots, may read.

From Bisbee the material will be hauled by mule teams along the proposed line. The reconnaisance was made by Lieut. Averill of the Seventh cavalry a few weeks ago. Heliographic stations will be established in the surrounding country, as they may be deemed necessary. By means of them the whole territory can be kept under the eye of the government.

PARIS WIRES LONDON VIA NEW YORK.

An incident of the general demoralization of the telegraph lines by the recent gales in Europe was the exchange of messages by commercial cables between Paris and London by way of New York. The route followed was in the underground line from Paris to Havre, ocean cables from Havre to New York, and ocean cables from New York to Weston-

Super-Mare. It is noteworthy that, with the exception of the short line between Weston-Super-Mare and London, the messages completed their long transits by wires entirely removed from the disturbance of the elements.

ELECTRIC LIGHTING.

ELECTRICITY AT ST. ELIZABETH'S U. S. HOSPITAL FOR THE INSANE.

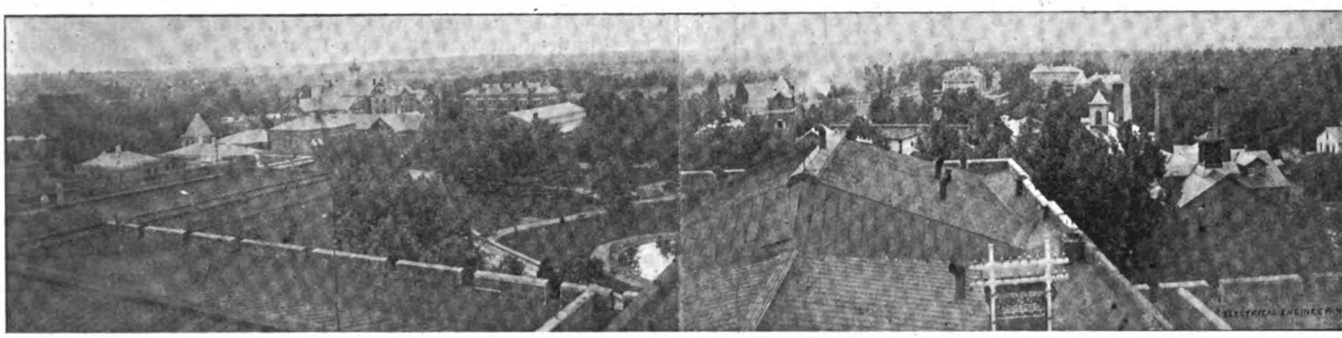
If you look off from the West Terrace of the Capitol at Washington, over the mass of green foliage that covers the city, past the Navy Yard and across the Anacostia River—a branch of the Potomac—you will see upon a commanding height clothed in verdure, and itself half enshrouded, half revealed, the long majestic Administration Building of St. Elizabeth's, the Government Hospital for the Insane. Beneath its shadow, and in the fifty other buildings that cover the beautiful grounds and complete this retreat for the mentally infirm, two thousand three hundred people are provided for.

To reach the asylum from the city is something of a journey, involving crossing the river and climbing a road which ascends seemingly interminable hills. At the top, however, you find a level bit of table land, and here you are confronted by the usual high brick wall, which does not prevent some patients from "eloping," as the authorities term it; for they spend hundreds of dollars annually in rewards for reclamation.

If your business is satisfactory to the lodge warden, you are passed, and the great iron gates clang behind you. From the moment of hearing the clang you are conscious of a watchful care, which surrounds everybody and everything, extending even to the grounds, which are beautifully laid out and tended. Velvet lawns stretch away in all directions, dotted with groups of magnificent trees, and illuminated by artistic flower beds in bright hues. Broad driveways and paved walks extend in graceful curves through the groves and past trim but substantial buildings. The main walk disappears in shrubbery, above which can be seen the majestic proportions of the Administration Building.

The Administration Building faces the city of Washington and is almost a thousand feet long. It contains the offices and quarters of the resident staff, and in its wings the temporary receiving ward, and a female ward. From its front, on the brow of the hill, a magnificent view of the environs of the Capital is obtainable. From its roof, whence our bird's eye view was taken, the extent of the institution can be perceived. The grounds cover nearly eight hundred acres, and there are fifty-one buildings on them.

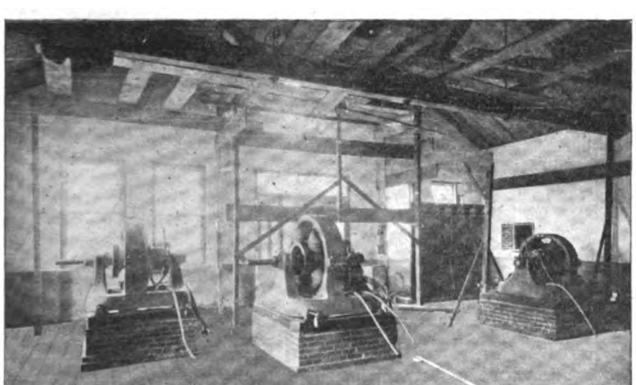
The hospital was established by act of Congress, March 3, 1855; and it is managed by a board of nine citizens of the District of Columbia, appointed by the President. The immediate government is in the hands of a resident superintendent, who is the responsible head of the whole—medical, financial and executive; feeding, clothing, housing, and attending professionally a family of two thousand sick people, directing the disbursement of hundreds of thousands of dollars annually, and of necessity on the qui vive all the time to keep abreast of the times in all his manifold occupations. The present incumbent is Dr. W. W. Godding, a man of more than national reputation, of the highest possible professional standing, wide attainments, wonderful executive ability, and above all of a very genial and lovable nature. He is assisted by an able corps of physicians, but where the responsibilities are so vast unity of head becomes a necessity, and on the judicious exercise of his individual responsibility the success of the hospital depends. The value of the property is now over a million dollars, and the annual expenditures are not far from a half a million.



BIRD'S EYE VIEW OF ST. ELIZABETH'S, GOVERNMENT INSANE ASYLUM, WASHINGTON, D. C.

The buildings with their patients are divided into six groups, viz.: 1, the Central Male, with 19 wards, 400 inmates; 2, the Female, with 20 wards, 375 inmates; 3, the Criminal and Homicidal, with 8 wards, 120 inmates; 4, the Male Chronic, with 13 wards, 500 inmates; 5, the Southern or sick, with 9 wards, 200 inmates; and Goddingscroft, a settlement of 50 mild cases who are employed as farmers. Each department is under charge of its respective physician, with head nurse, nurses, keepers, helpers, etc.

Up to a comparatively recent date the institution had made small use of electricity. As far as therapeutic uses go next to nothing had been done and in respect of the practical applications nothing at all. The many buildings have been lighted by gas, to supply which the hospital has its own gas works. The cooking, which of course is on a very large scale, has been done by steam or on ranges. Heating has been by steam as far as possible. The mechanical treatment of patients, such as massage, has been by hand. The stacks of the battery of heating boilers, of the gas house and the main kitchens, may be seen at the extreme right of the bird's eye view. The system of heating has been very complete of its kind, and in

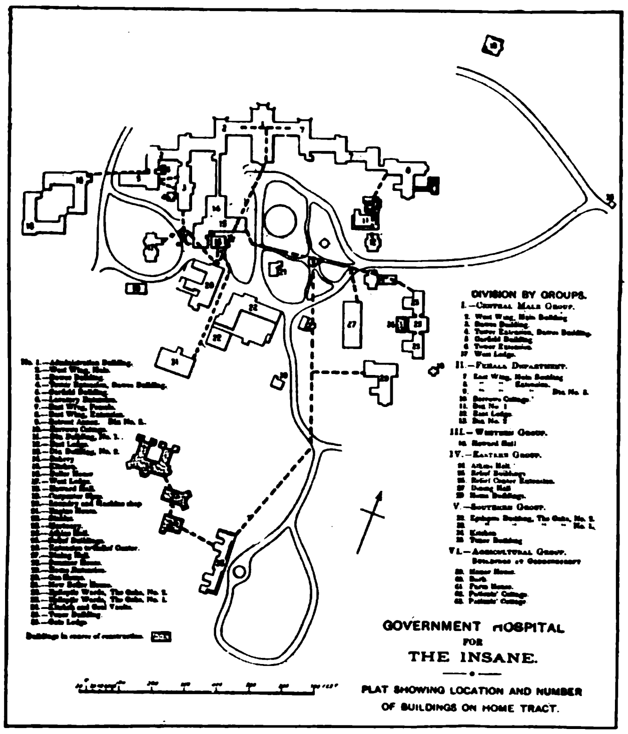


THE DYNAMO ROOM.

THE POWER HOUSE.

connection with this may be mentioned what is the most striking feature of the institution from an engineering standpoint. Every group of buildings, near and far, shown in the general plan view is connected with all the other groups, and every building with all the others by an elaborate series of underground galleries, or tunnels, indicated by dotted lines on the plan below.

These tunnels are necessarily miles in extent, and as seen in



THE GOVERNMENT INSANE ASYLUM AT WASHINGTON.—TUNNEL CONNECTING BUILDINGS SHOWN IN DOTTED LINES.

the engraving, they are all (with one exception in the old building), well lighted and ventilated. The tunnels are arched with brick and masonry, paved with brick and flags, and have narrow gauge tracks for the accommodation of small hand cars which are used for the transportation of supplies. Most of the food prepared at the main kitchen is distributed in this way. The steam pipes, well jacketed, are carried upon cast iron brackets let into the walls of the tunnels, and are carried to all the buildings. This construction may be seen on the left of the tunnel picture. Gas and water pipes are carried on the ground, as shown. It is possible, through the tunnel system, to traverse every building in the grounds, a half day's journey, without passing above ground.

The water supply of the institution is obtained from artesian wells located in the lower part of the grounds, near the river. On the shore a pumping station is located, containing the boilers and pumping engines, a large and small pair, which raise the water from the river level to a tank in the attic of the Administration Building.

For a long time the management of the institution have realized that in electricity a potent agent lay idle, and active steps have been taken during the last year to remedy the defect. More than a year ago a complete telephone system was installed. The Central office is located in the pharmacy, on the main corridor of the Administration Building, and from there the circuits, which are metallic, are carried up to the roof in a Kerite cable, whence they are carried on the buildings and poles through the grounds. The instruments are microphones, and the outfit is of the most modern type. The materials were furnished by Kennedy & Du Perow, and the work of installation done by J. U. Burket, of Washington. The scheme is to connect every ward and department directly with the superintendent and head quarters, as well as with each other. In addition there are telephones in the pumping station, the dynamo room, and the stables, so that everything is under direct control.

Early in 1895 bids were opened and contracts awarded for boilers, engines and dynamos, and the work of constructing and installing a modern electric lighting system undertaken. It was felt that this was a work of such magnitude, on account of the difficulties to be encountered and the conditions to be met, that it would be unwise to let the construction work out, and so lose control of the work in point of time and manner of working. It was decided to retain an engineer, and do all construction in the buildings by day labor. This gave the added advantage of enabling the institution to employ many of its inmates who are more or less skilled mechanics, and are tractable. In pursuance of this, Mr. Michael J. O'Donnell, for a long time the manager of the Potomac Light and Power Company, was engaged, and under his able direction the work has now progressed so far that about six thousand lights are installed, and the plant is in such shape that it can be started up at any time.

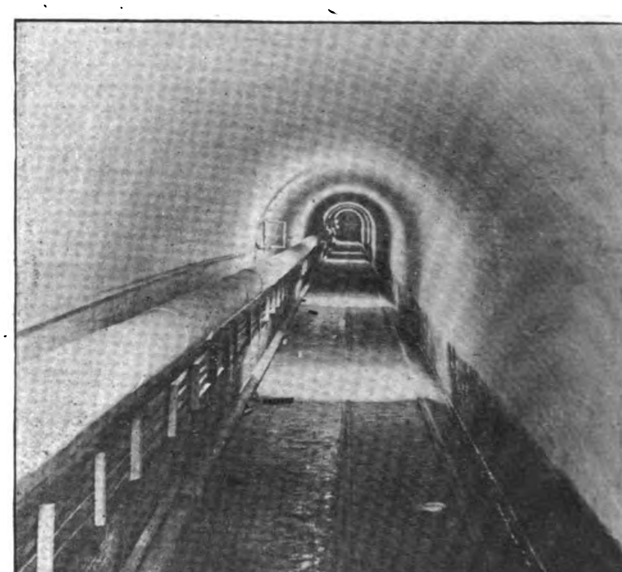
In laying out the wiring plans, it will be apparent that peculiar conditions had to be met. It was not sufficient to satisfy the insurance inspectors touching the character of the work, but it was demanded at the outset that the risk of fire should be absolutely nil, that all wires and fixtures should be beyond the reach of meddling or mischievous patients, and that the work should be done without disturbing the regular routine of the institution. In case of fire nothing on earth could control 2,000 lunatics.

Under these conditions Mr. O'Donnell went to work, and although more money has been expended than the most liberal estimates provided for, it is believed that the result is a system which can scarcely be equalled for thoroughness and perfection of material and workmanship in the country. Two hundred and twenty-one thousand feet of Kerite wire have been used.

The three-wire system has been employed. A new dynamo house was built of brick, one story high, 60x100 feet, which contains the engine room and a boiler room, separated by a space containing the condensers. Our engraving shows a view of this taken before it was finished, with the forty-foot iron stack on the ground.

The boilers so far installed are two in number, and were furnished by the E. Keeler Company, of Williamsport, Pa. They are of horizontal tubular type, built to specifications specially drawn for this work. They are tested to 150 pounds, and are calculated to furnish 400 horse-power. The battery is expected to be duplicated before the plant is fully in operation.

There are two pair of dynamos and two engines. The engines are Armington & Sims, high speed, cross compound, horizontal, condensing, with two cylinders, opposite cranks, automatic cut-off; and are connected to the dynamos by rope drives of four-strand manilla ropes. The cylinders of the larger engine are 13 and 20½ inches diameter, with fifteen-inch stroke, making 265 revolutions per minute, and giving 200 indicated horse-power. The two rope wheels for this engine



TUNNEL CONNECTING BUILDINGS OF GOVERNMENT INSANE ASYLUM, WASHINGTON.

are 74 inches on the pitch line and have each eleven grooves for ¾-inch rope.

The smaller engine has 10½ and 16½-inch cylinders with 12-inch stroke and makes 285 revolutions per minute with 100 indicated horse-power. The rope wheels for this engine are 74 inches on pitch line and are scored for six ropes. Stratton separators and Baird steam traps are used, with Davidson jet condensers.

There are two pair of dynamos, General Electric multi-polar compound wound, self-regulating. The larger pair give 100 kilowatt and the smaller pair 50 kilowatt at 125 volts. This part of the plant is also to be duplicated. The larger pair have rope wheels 30 inches in diameter, the smaller 17¾.

As all the buildings are grouped more or less regularly on a level table land, the scheme of distribution is simple. At the power house a slate switchboard is provided, with separate cut-outs, ammeters and voltmeters for the dynamos. From this switchboard eleven No. 0000 bare copper feeders, three No. 6 pressure, and two No. 8 extra wires, at present used for telephone, are run on poles up the hill 2,700 feet to the main distributing station at X, back of the Administration Building, in the plan. Here is located the distributing switchboard, of marbleized slate, equipped with cut-outs, section switches, Weston instruments, etc. It will be noted that this board is set out in the middle of the station. It has a space 10 x 12 ft. behind, and a chamber 10 x 4 x 6 ft. built under the board, allowing ample clearance for the cables and wires, and giving free access to everything at all times. Access to the lower chamber is by a flight of stone steps. From this chamber the cables pass into the main tunnel under the Administration Building, and thence branch into the other tunnels, as indicated in dotted lines on the plan, to their respective groups of buildings. The main tunnel was found damp in some places, necessitating the use of lead-covered cable.

The total Kerite cable used was 12,742 feet, the largest having 860,000 circular mils. The cable runs may be seen at the left of the tunnel picture, where they are shown in moulding. The lead-covered cable was carried on iron brackets let into the brick work. At each branch tunnel and wherever the tunnels enter the buildings branch, or junction, cut-outs of the standard G. E. type for three-wire system are used. The tunnels are lighted by sixteen candle-power lamps at intervals of 100 feet, and wherever these lamps are placed on the run of a cable the necessary feeders are run back to the last junction cut out, no taps being allowed on any cable.

From the junction boxes in the tunnel entrances the main feeders for each building are run through special flues. On each floor are located small switchboards fitted with cut-outs, fuses, etc. All these boards are of slate or hard wood of special design and are set in recessed spaces in the corridor walls with flush doors fitted with Yale locks. The flues open into the recesses behind the boards, and the whole construction is such that unauthorized interference without the aid of tools is impossible.

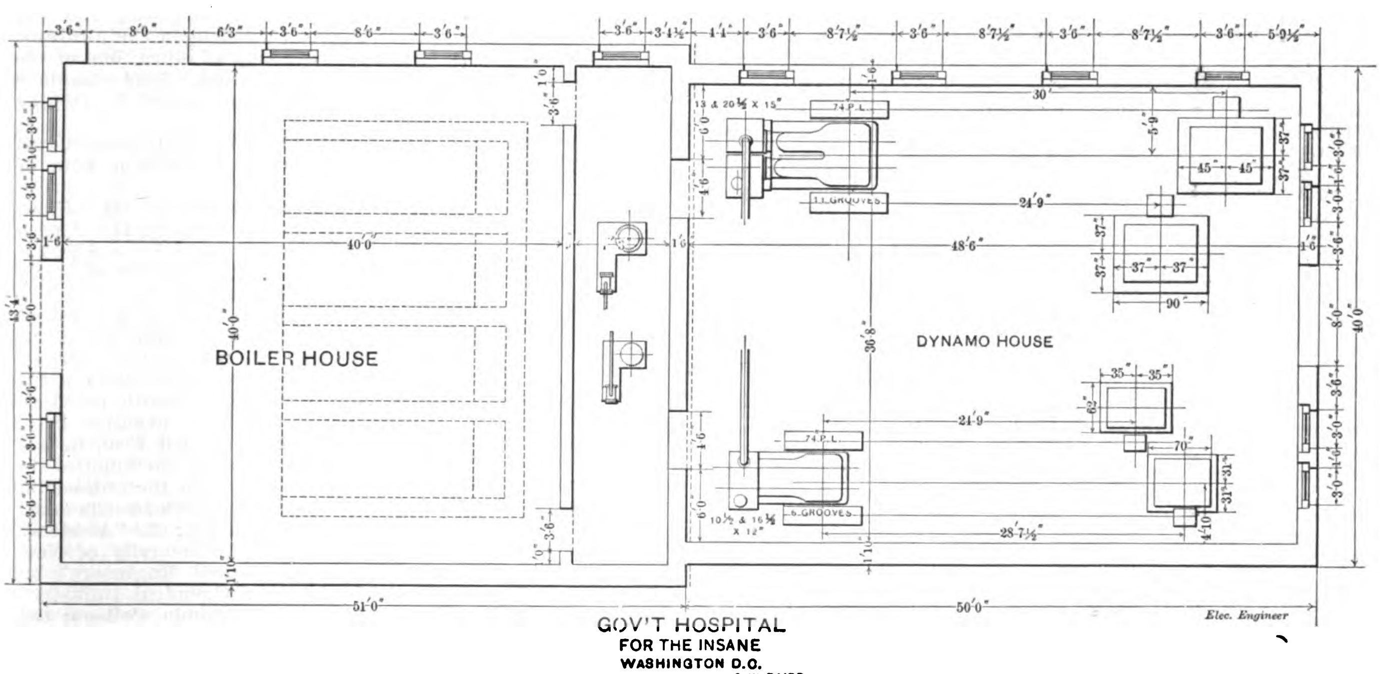
In wiring the buildings concealed work was done of necessity in all but the Administration Building. And in nearly all the buildings the work was performed under the greatest difficulty. In the Administration Building capped moulding was used, of which 30,340 feet was required. In one or two of the female wards it was found possible, because of the height of the ceilings, which were fireproof arches, to use moulding. In these cases stout bridge pieces were wedged firmly across the narrow arches between the webs of the girders and above the flanges and to these the moulding was secured by screws. In all the buildings now occupied where concealed work was done it was found necessary to cut the plaster, and all the wires in addition to their heavy insulation were encased in Circular Loom flexible conduit. In wiring these buildings, 15,532 porcelain tubes were used and 62,000 feet of Circular Loom tube.

In wiring the new buildings, which were under process of construction, a system of floor conduits was adopted which was unfortunately precluded in the older buildings. These buildings are fireproof, the floors being hard wood over iron and masonry arches. Upon the masonry in a bed of cement were laid shallow conduits with slate sides top and bottom. At convenient points, such as outside each room door, portions of the floor are made removable by being screwed down. Under these, pockets are formed, the slate covers of which are loose, and from these pockets the wires in their Circular Loom tubing can be readily drawn or pushed into place, the interior of the conduit being comparatively smooth. In all cases where joints are made in the Circular Loom covered wire the joint is taped and the tap wire taped to the other closely and the joint and taped portion drawn back into the tubing, an extra piece of split tube being then placed around the whole and taped over.

Throughout the entire system each floor is balanced at the floor switchboard and each building is balanced by itself. As those lamps which are to burn all night are readily ascertained, and as the entire system is organized to be worked as a matter of routine by the attendants, it has been possible to balance both the maximum and the minimum loads once for all. Thus the attendant at the proper hour by throwing the switches on the floor switchboard can cut out all but the night lights. The telephone connections between the wards, the distributing station, the dynamo room and the superintendent's office render the whole a perfect machine under perfect control.

Most of the fixtures are ceiling clusters, out of reach, as they are never to be touched except to replace lamps. All of these appliances have been made to order from original designs by the well known firm of Kennedy & Du Perow, of Washington. The chandeliers, all small switchboards, cut-outs, etc., as well as all the wire and cables and the Circular Loom tubing were furnished by the same firm, and in all the complex dealings which were necessitated during the progress of the work there does not seem to have been a hitch.

The lighting system being in operative condition it is the intention of the superintendent to introduce electrical appliances wherever possible, $6,000 for electric fans alone being estimated for next summer. Incandescent arc lamps are to be used for lighting the grounds, electrically heated warmers are to replace the steam tables to keep the food from cooling while serving. It is only a question of time when the current



PLAN OF ENGINE AND BOILER HOUSE, GOVERNMENT INSANE ASYLUM, WASHINGTON, D. C.

will be used for all sorts of purposes in the wards. Small motors have been found very convenient to run the massage machines now coming into general use, and as the 110 volt current has demonstrated its ease of manipulation for therapeutic purposes, the proper apparatus may be carried to any ward for use without a battery. Thus electrically lighted endoscopes, X-ray apparatus and even the bath cabinets lined with incandescent lamps devised by Dr. Kellogg, of Battle Creek, described in The Electrical Engineer of September 30, can be used where required without trouble.

SOCIETY AND CLUB NOTES.

M. MOISSAN ON THE ELECTRIC FURNACE.

THE MOISSAN BANQUET.

On the evening of October 27, M. Henri Moissan delivered a lecture on "The Electric Furnace" at the College of Physicians and Surgeons. This lecture was given by invitation of the New York Academy of Sciences, The New York Section of the American Chemical Society, The American Institute of Electrical Engineers, The College of Pharmacy of the City of New York, and the New York section of the Society of Chemical Industry.

After a most enthusiastic welcome from the audience which completely filled the hall, M. Moissan introduced his subject by pointing out that while the carbon compounds have been studied with great care by organic chemists during the past fifty years, the study of the different stages through which carbon passes had been comparatively neglected. In his endeavors to obtain pure carbon, the ordinary amorphous carbon, lampblack, containing from 10 to 15 per cent. of impurities, he had found it necessary to use very high temperatures and had succeeded in obtaining one form of pure carbon, graphite. High temperature alone, however, would not yield the crystallized form of carbon, diamond. He set to work to find out the composition of diamonds by reducing some to ashes. In all, whether they came from the Cape of Good Hope or from Brazil, he found iron, save in one very pure green hard stone from Brazil. By the study of the nature of the ground and of the geological formation in which Cape diamonds are found, he found that the earth, besides graphite and microscopic diamonds, always contained granite. Granite is the product of great pressure, and this fact led him to the idea that diamonds might also be obtained by pressure. As cast iron increases in volume in passing from the liquid to the solid state, he was led to believe that if an element of carbon were enclosed in a globule of cast iron that was cooling it would be subjected to the requisite pressure.

In order to obtain a heat sufficiently great and at the same time to be able to measure it, he devised the simple form of electric furnace with which the experiment last Tuesday was performed. It consists of two lime or chalk bricks, the lower one about eighteen inches square and a foot deep, the upper one about six inches deep. In the lower one is hollowed out an elliptical hole to contain the crucible, while two carbon electrodes pass from the cavity to the exterior, where they are connected with the source of current. The upper brick serves for a cover. M. Moissan first sprinkled the cavity with magnesia in order to prevent the formation of calcium carbide. He then placed in it the graphite crucible, into which he had put some soft iron filings and charcoal, covered it with the top brick, and turned on the current.

In three minutes the indicator showed a temperature of 2,500° Fahrenheit. The chalk was boiling and flaming before the eyes of the audience when M. Moissan put his hand on the top brick and kept it there to show that the heat did not come through.

At the end of ten minutes the process was complete. M. Moissan lifted the top with his hands, though its under side was white hot, and after holding it up for a while dropped it into some water.

The crucible he took out with tongs and also dropped into cold water. He explained that the first time he had cooled the mass in that way he had taken every possible precaution, expecting an explosion, but that after repeating the process three hundred times without an accident he felt that the audience was safe.

On breaking the crucible he took out an ingot the size of a bullet and explained the processes by which the iron would have to be eliminated in order to get at the crystallized carbon that was probably within it. The diamond will have no commercial value, as the largest he has succeeded in making is only one millimeter in diameter.

The form of the crystals varies according to the method used in cooling. When water is used the diamond is often full of black specks which detract from the value of a stone. M. Moissan was delighted to discover these spots, as they proved to him that he was following in the track of nature.

When molten lead is used to cool the crucible the crystal takes the shape of a small rectangular figure, sometimes with the sharp edges rounded, but when mercury is used the crystal is a regular octahedron. Some of the last, when exposed to the air, split, as has happened to some of the diamonds found at the Cape. This was an additional proof to M. Moissan that diamond is produced under strong pressure.

His conclusion is that at the ordinary temperature carbon does not liquefy, but changes at once from a solid into a gas, always taking the graphitic form, and that only under pressure does it take the "liquid" form, diamond.

The rest of the lecture was taken up with a hurried review of the other products obtained by M. Moissan by means of the electric furnace, metallic chromium, molybdenum and tungsten. These, with many of the oxides supposed to be irreducible, which have yielded to the furnace, he had on the table in glass jars. He spoke particularly of the excellent qualities of molybdenum steel.

He ran over the properties of the long list of carbides discovered by him, and produced acetylene gas before the audience by putting some lithium carbide into a jar of water, which thereupon bubbled up, after which he touched the gas off with a match, producing a brilliant flame. It smoked so much that after two minutes the jar was removed, and during the rest of the evening smoky filaments kept falling upon the auditors.

The last experiment was the volatilizing of silica, one of the latest of M. Moissan's scientific achievements. This was done in the electric furnace, a glass globe placed over it catching and condensing the vapors.

At the end of the lecture, which was frequently interrupted by applause, Prof. R. Ogden Doremus proposed a vote of thanks to the lecturer.

M. Moissan was assisted in his experiments by Mr. C. O. Mailloux, who was delegated for that purpose by the American Institute of Electrical Engineers. The Edison Electric Illuminating Company also kindly loaned a number of heavy rheostats and other apparatus for the occasion.

As an acknowledgment of the lecture and as a farewell mark of esteem, a banquet was given to Prof. Moissan at the Hotel Waldorf on Wednesday evening, when about 50 sat down to table. Prof. R. Ogden Doremus, of the College of the City of New York, presided, and Mr. T. C. Martin acted as toastmaster. To the toast of the guest of the evening, Prof. Moissan replied in the clear, terse and beautiful French that made his lecture so enjoyable, and he also participated in one or two of the discussions that arose as to the outlook in the chemical and electrical arts. The "American Chemical Society" was responded to by Dr. C. B. Dudley; the "Academy of Sciences" by Prof. Morris Loeb of the University of New York; the "American Institute of Electrical Engineers" by Prof. F. B. Crocker, and the "Society of Chemical Industry" by Prof. C. F. Chandler, both of the Columbia College; the "College of Pharmacy" by Dr. Wm. Jay Schieffelin; the "Civil and Mechanical Engineers" by Dr. C. E. Emery, president of the New York Electrical Society; the "Expert and Allied Sides of the Chemical Arts" by Dr. A. R. Ledoux; "Technical Literature" by Dr. Park Benjamin, and the "Chemical Manufacturing Industries" by Mr. I. J. R. Muurling. Among those subscribing to the banquet, and nearly all of whom were present, were E. D. Adams, Edward Weston, C. O. Mailloux, Dr. S. Sheldon, Prof. C. A. Doremus, Herbert Laws Webb, W. Diestel, W. McMurtrie, B. Lillard, Dr. C. T. Hutchinson, Dr. Louis Duncan, J. W. Lieb, Jr., H. Ward Leonard, W. D. Edmonds, E. N. Dickerson, Dr. P. T. Austen, Prof. A. R. Leeds, Prof. A. H. Mason, D. O. Haynes, publisher of the "Pharmaceutical Era," G. F. Kunz, the gem expert of Tiffany's, and many other well known men.

Prof. Moissan, accompanied by his wife and son, sailed for France on Saturday.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

Mr. C. M. Goddard, secretary of the above association, has issued a circular letter announcing the meeting which is to take place in New York on Dec. 8, and asking for suggestions as to any desirable changes in the rules for electric light and power wiring.

INTERNATIONAL ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS.

The above association formed recently with Mr. Frank C. Mason as president, has already issued its first report, prefaced by portraits of the officers. Mr. Ralph W. Gordon, vice-

president of the Gordon-Burnham Battery Company, writing to the president says: "I enclose herewith my check for $25 in payment of my dues as an associate member of your association. After conversing with many superintendents throughout the country, I am confident that the future success of the association is now assured." This is but one out of many such letters of encouragement and good will.

THE OHIO ELECTRIC LIGHT ASSOCIATION.

The annual meeting of the Ohio Electric Light Association was held at Springfield, Ohio, on Oct. 13. The meeting was a most successful one in every way; the attendance being good and the discussions which occurred most interesting and helpful. The next annual meeting of the association will be held in Cincinnati, on the second Tuesday in October, 1897. The officers elected for the coming year were as follows: President, John I. Beggs, Cincinnati; vice-president, Geo. S. Long, Bowling Green; secretary and treasurer, Sam'l Scovil, Cleveland.

PERSONAL.

DISMISSAL OF THE CHARGES AGAINST SUPT. SMITH OF THE NEW YORK FIRE TELEGRAPHS.

FOR some time past, Mr. J. Elliot Smith, the superintendent of the Fire Telegraph service of New York City, has been on trial before the Board of Fire Commissioners, on charges of fraud and incompetency. A large amount of evidence was taken, and counsel were employed on both sides. The Commissioners have dismissed the charges, and Mr. Smith, who was suspended, has been reinstated.

President Sheffield said that as all the law points had been disposed of at a former meeting, a decision would be made on the questions of fact in relation to the charges that had not been disposed of. Secretary Jussen read the charges and they were acted upon separately.

On the first charge it was alleged that Mr. Smith fraudulently prepared contract specifications so that no one could fully understand them, and for the purpose of giving the Standard Underground Cable Company an advantage over other bidders. Commissioner La Grange said that the city had lost $100,000 by Mr. Smith's method of drafting specifications, but when a vote was taken he cast his with the other Commissioners, and the charge was dismissed.

The second charge was that Mr. Smith conspired with the Pierce & Jones Company to permit it to furnish supplies to the department at exorbitant rates. Commissioner La Grange voted to sustain the charge. Commissioner Sturgis and president Sheffield voted to dismiss it on the ground that as there was no clear proof of fraud, it must be assumed that Mr. Smith acted in good faith within his discretion. The charge was dismissed.

On the third charge, alleging that Mr. Smith bought supplies from the Standard Underground Cable Company at exorbitant rates, the vote was the same as on the second charge, the commissioners who voted to dismiss saying that the prices paid were reasonable under the circumstances. The charge was dismissed.

Commissioner La Grange voted to sustain the fourth charge, which alleged conspiracy with many persons to defraud the city by means of exorbitant prices. The charge was dismissed by the votes of President Sheffield and Commissioner Sturgis. The fifth charge, alleging incompetency in preparing contracts for underground cable work thus preventing intelligent bidding; the sixth charge, which alleged failure to properly inspect and keep a record of underground cable work; the seventh charge alleging a conspiracy with the Pierce & Jones Company to compel charitable institutions to connect with the fire alarm system through the Pierce & Jones Company, were all dismissed by the votes of President Sheffield and Commissioner Sturgis, Commissioner La Grange voting to sustain.

In the eighth charge, Mr. Smith was alleged to be incompetent in having permitted the alarm system to deteriorate, thus causing fires. Commissioner La Grange, in voting to sustain the charge, said that the New York fire alarm system was inferior to those of other cities in this country. The other commissioners admitted that certain features were not as perfect as they should be, but refused to hold Mr. Smith responsible for them, and dismissed the charge.

The charges being disposed of, a motion to reinstate Mr. Smith was made and carried, Commissioner La Grange again voting in opposition to the two other commissioners.

MR. R. R. BOWKER, vice-president of the Edison Electric Illuminating Company, of New York, has found time recently for two very interesting literary productions, one being an instructive paper on "Electricity" in the October "Harper's Magazine," and the other some personal recollections of George du Maurier, in the New York "Times," of Sunday, Oct. 25. Both are extremely well worth reading.

MR. F. R. UPTON, who is so well known in the electrical field as manager of the Edison Lamp Works, and who is now manager of the sales department of the huge McKeesport Tube Works, near Pittsburg, was a recent visitor to New York, where many old friends were delighted to see him and to exchange news. Mr. Upton looks well and is very busy.

OBITUARY.

MONROE GREENWOOD.

The death is announced of Mr. M. Greenwood, the president of the California Electrical Works and vice-president of the Sunset Telephone and Telegraph Company, after a week's illness, at San Mateo, California. He was sixty-eight years of age. He was a Mississippian, and went to California in 1851. Two of his sons hold responsible positions in the Sunset Company.

LETTERS TO THE EDITOR.

"SILVER TO GIVE AWAY."

Your editorial in issue of Sept. 30, 1896, entitled "Silver to Give Away," based on matters contained in article copied from "Engineering and Mining Journal," in relation to plant of Anaconda Mining Company, of this city, is evidently written, as editorials too often are, without proper comprehension of the subject. It is a fact known to "Engineering and Mining Journal" and to all persons familiar with the Silver Bow mining district, that neither the Anaconda Company nor any other of the large copper companies could work its mines at a profit if it were not for the by-products of silver and gold, and conversely the silver and gold could not be mined without the copper. This same condition applies to most of the large copper producers of the United States, outside of Lake Superior district. Hence the large development of the electrical industry, made possible by the reduced price of copper, is almost directly due to silver, the greatest by-product. Your deduction as to possible increase of production is an exaggeration beyond the practical in mining, and can only make one laugh who has some knowledge of mines and the mining country, but may be swallowed whole by some of our more benighted brethren in the electrical field.

D. S. SIMPSON,

Butte, Mont., Oct. 23. Rocky Mountain Bell Telephone Co.

(None of the figures were ours, but were furnished by the expert of the Anaconda mine, who ought to know what he is talking about. It was shown that the company with a capital of $5,000,000 paid a dividend of $750,000 last May; another being now due, or paid. The company gets practically the same price for its copper as the Lake Superior mines, and has all its silver as a "side show." Mr. Morrell, speaking for the silver and copper mines of the West, said that they stand to make yearly $36,000,000—out of the Government—if the free coinage of silver went through. If this makes anybody "laugh" it does not make us do so by any means.—Ed. E. E.)

LEGAL NOTES.

DAMAGES FOR VIBRATION BY LIGHTING PLANT.

The case of T. J. Preston & Company, linseed oil makers, Newark, N. J., against the Newark Electric Light and Power Company, to recover $100,000 for damages to Preston & Company's building and business by the the vibration of the machinery in the company's building, ended recently in Judge Depue awarding plaintiff $5,000. By agreement a jury was dispensed with and the case submitted to Judge Depue, as the principal contested points were of a legal nature.

THE BROOKLYN SUBWAY COMMISSION went out of existence November 1. It was created in 1892, for a term of four years to put the Brooklyn wires underground, but there are more wires than ever overhead and all efforts to extend the life of the commission have failed.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Current:

ALTERNATING FROM DIRECT CURRENTS.—By Lieut. F. Jarvis Patten. Paper read before the National Society of Electro-Therapeutists. Illustrated description of a simple device for transforming direct into alternating currents of a pure sine curve.—"Elec. World," Oct. 17, '96.

EXPERIMENTAL STUDY OF INDUCTION PHENOMENA IN ALTERNATING CURRENT CIRCUITS.—By F. E. Willis. Results of some experiments made upon circuits containing resistance, self-induction and capacity.—"Phys. Rev.," Sept.-Oct., '96.

Central Stations:

CENTRAL STATION AT ZURICH.—By M. Jacquine. A water power plant running 10 dynamos of about 150 h. p. each. Alternating current is sent to substations where the current is rectified by means of the Pollak rectifier and utilized to charge storage batteries.—"L'Eclair. Elec.," Sept. 12, '96., and subsequent issue.

THE NEW STATION OF THE LONG ISLAND CITY ELECTRIC ILLUMINATING AND POWER COMPANY.—Station consists of four 400 h. p. boilers, working on a pressure of 125 pounds; there are two engines. There are eight 50-light T.-H. arc machines running from countershafting, two 80-light Brush machines, wound on the three-circuit plan; two Westinghouse two-phase generators form the machinery for power purposes.—"Elec. World," Oct. 17, '96.

Electro-Chemistry:

IMPROVED METHOD OF ELECTRO-PLATING.—Articles are placed in large quantities in a revolving container, which is suspended or supported within the electrolytic bath, and during the time deposition is taking place is subjected to a rotary movement varying from fifteen to fifty revolutions per minute.—For details see "Scien. Am.," Oct. 10, '96.

ELECTRIC SMELTING FURNACE.—Illustrated description of a furnace patented by Joseph A. Vincent, of Phila.—"Iron Age," Oct. 8, '96.

Electro-Physics:

VELOCITY OF ELECTRIC WAVES.—By Clarence A. Saunders. Author gives the history of the subject and then follows it up with a careful set of researches.—"Phys. Rev.," Sept.-Oct., '96.

ON A COMPLETE APPARATUS FOR THE STUDY OF THE PROPERTIES OF ELECTRIC WAVES.—By Jagadis Chunder Bose, M. A. Paper read before the British Assoc. for Adv. of Science.

MUTUAL INDUCTION IN PARALLEL DISTRIBUTING CIRCUITS.—By Dugald C. Jackson. Writer shows that the mutual inductance of any two parallel circuits of indefinitely great length may be easily calculated, provided the distances apart of the different wires composing the circuits are known.

Isolated Plants:

ELECTRIC INSTALLATION OF THE MOHAWK BUILDING, CLEVELAND.—This plant consists of three 60 x 16 horizontal, tubular boilers, three Ball engines, working at 90 pounds' pressure, to which are directly coupled three 25 k. w., 115 volt, 240 ampere dynamos.—"Elec. World," Sept. 19, '96.

SMALL ELECTRIC LIGHTING PLANTS FOR COUNTRY HOUSES.—It is shown in a short article how successfully small isolated plants may be run in country houses, by means of oil engine, dynamo and accumulator.—"Lond. Elec. Rev.," Sept. 18, '96.

Lighting:

LIGHTHOUSE ILLUMINATION.—By C. S. Du Riche Preller. An elaborate and valuable series upon coast and lighthouse illumination in France.—Abstracted from "Engineering" in "Progr. Age," Oct. 1, '96.

LIGHTING BY ACETYLENE.—By G. Pellissier. Illustrated description of electric furnaces used at Spray and Niagara; also special design by Bullier.—"L'Eclair. Elec.," Sept. 12, '96.

Magnetism:

ON THE MAGNETIC BEHAVIOR OF ELECTROLYTIC IRON, NICKEL AND COBALT.—By W. Leick. Author obtained his deposits from the following three solutions: 1, Ferrous sulphate; 2, Ferrous chloride; 3, Iron ammonium sulphate.—Results obtained from these deposits are stated in tabular form in Lond. "Elec.," Sept. 18, '96.

Measurements:

MEASUREMENT OF POWER IN TWO AND THREE-PHASE CIRCUITS BY MEANS OF WATTMETERS.—A short article explaining methods of connecting and reading results.—"Elec. World," Sept. 26, '96.

AN ARRANGEMENT OF RESISTANCE BOXES.—A number of resistance coils shown in skeleton form.—"Electricity," Sept. 16, '96.

Mechanical:

HORNSBY-AKROYD OIL ENGINE.—Description of engine with illustrations.—"Can. Elec. News," Oct., '96.

Mining:

ELECTRICITY DOWN A COAL MINE.—Illustrated description of the Abercanaid Colliery, England.—"Lond. Elec. Rev.," Sept. 18, '96.

Power Transmission:

SHAFT AND ELECTRIC TRANSMISSION.—Diagrams presenting results of power tests made in a factory. The first shows the estimated friction loss in the engine, the loss in shafting, belts, etc., and the useful work performed during a working day. The second indicates the same loss in the engine, the constant losses in the dynamo, the variable losses in the motors and line, and the useful work. In the first case the average indicated horse-power was 44.1 and in the second 25.7. The total loss in the first case was 31 horse-power and in the second about 13 horse-power.—"Iron Age," Sept. 17, '96; "Railway Rev.," Oct. 3, '96.

LIGHTING AND POWER COMBINED.—It is shown that in many cases economical results are obtained by running lighting stations in connection with railways, and furthermore it is shown that advantages may be derived from running storage batteries in connection therewith for two reasons; first, batteries going down hill may charge; secondly, the steam engine runs more uniformly.—"Die Elektrizität," Sept. 5, '96.

ELECTRIC TRANSMISSION AT NEUCHATEL.—Transmission of power is accomplished by means of three-phase currents, while for lighting the single-phase current is employed. Detailed description in "Elektrotechn. Anz.," Oct. 1. '96.

ECONOMIC USE OF ELECTRIC POWER FOR DRIVING TOOLS.—By Reginald A. Fessenden. Paper read before the Eng's. Soc. of West. Penn. Author explains by calculations the great saving to be obtained by electric transmission in shops, showing that if we can increase the output by 10 per cent. we can afford to pay 17½ per cent. of the entire first cost of the plant for the apparatus to do it.—"Iron Trade Rev.," Oct. 15, '96.

Railways:

POWER FROM THE TROLLEY CIRCUIT.—By H. S. Newton. Paper read before the N. Y. State Str. R'way Assoc., Sept. 8, 1896. Author presents the following questions: Is it practicable? Why do Fire Insurance Companies object? What should be done to overcome the objections? The first author answers in the affirmative and shows by a numerical example the benefit which may be derived.—"West. Elec.," Oct. 3, 1896.

ELECTRICITY ON A STEAM ROAD.—The electric equipments of the Aylmer branch of the Can. Pac. R'y is described. It is to do passenger as well as freight service and the power station also supplies lighting from a monocyclic generator.—"Can. Elec. News," Oct., '96. See also Elec. Engr.

NEW GENERATORS AT THE NASSAU POWER HOUSE.—Description of two new generating units. Generators have a capacity of 2,000 amperes at 560 volts.—Illustrated in "Elec. World," Sept. 26, '96.

ELECTRIC RAILWAY BETWEEN MECKENBUEREN AND TETTNAUG.—A trolley road near Lake Constance run on a 700-volt circuit and used for freight as well as passenger service.—"L'Ind. Elec.," Sept. 10, '96.

Telephony, Telegraphy, etc:

HOUT'S AUTOMATIC TELEPHONE SYSTEM.—Each telephone in the system is provided with a call box, and at the exchange a central appliance is so arranged that any call box in the system can instantly electrically connect the telephone to which it is attached to any other telephone in the system without interfering with ony other telephone or any other conversation.—Illustrated in "Scient. Am.," Oct. 10, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCT. 20, 1896.

Alarms and Signals:—

SAFETY APPARATUS FOR RAILWAY CROSSINGS. G. Gibbs, Milwaukee, Wis., 569,709. Filed Dec. 13, 1893.
Consists of an insulating section in the trolley wire of the electric line at each approach to the crossing, a feeding connection with the insulated section through a switch, by means of which current is supplied to or cut off from the section at the will of the operator.

THERMOSTATIC FIRE ALARM. H. Baer, New York, 569,851. Filed March 7, 1896.
The thermostatic bar is constantly subjected to the influence of the heat of a suitable flame and the heating effect is interrupted in case of fire when the smoke extinguishes the heating medium and closes an electric alarm circuit.

CIRCUIT CLOSER FOR BURGLAR ALARMS. C. H. Dowden, Newark, N. J., 569,861. Filed Feb. 29, 1896.
For use in connection with windows.

Conductors, Conduits and Insulators;—

WIRE CONNECTOR. H. Haug, Newark, N. J., 569,713. Filed June 10, 1896.
Consists of a metal strip bent into the shape of two adjoining and connecting channels of different size and circular in cross-section, being adapted to receive the wires to be jointed and to be twisted together.

ARMORING OR COVERING FOR ELECTRIC CABLES. H. Edmunds, London, England, 569,748. Filed Aug. 27, 1896.
Consists of wires of ordinary round form alternating with wires having recesses at their sides in which the first named wires engage.

WIRE CONNECTOR. A. Gartner, Newark, N. J., 569,752. Filed June 10, 1896.
Consists of a metal strip bent into shape of an oval tube and having its edges overlapping and adapted to slide on each other, and adapted to be twisted together with the wires.

WIRE CONNECTOR. A. Gartner, Newark, N. J., 569,753. Filed June 17, 1896.
Similar to above.

Distribution:—

SYSTEM OF DISTRIBUTING ELECTRIC POWER, ETC. W. D. Gharky, Philadelphia, Pa., 569,634. Filed July 2, 1895.
A system of wiring automatic circuit breakers.

Dynamos and Motors:—

ELECTRIC MOTOR. H. B. Collins, Fulton, N. Y., 569,746. Filed Nov. 20, 1895.
A rotary pendant head and a motor for revolving the head, the motor being provided with an armature and a field magnet magnetically co-operating to effect an upward tendency of the revolving head during the operation of the motor.

ELECTRIC LIGHTING BY WIND POWER. J. W. Gibboney, Lynn, Mass., 569,754. Filed July 23, 1896.
The combination comprises an electrical generator, a fluid motor for operating it, a closed chamber of a fixed capacity in which the motor driving fluid is stored, a variable source of power operating to increase the pressure upon the fluid and a regulator controlling the admission of the fluid to the motor.

ELECTRIC MACHINE. A. Schmid, Pittsburg, Pa., 569,802. Filed Nov. 27, 1891.
The combination with the armature of an electric motor, of a four-pole field magnet constructed in two sections, one pole and a fraction of each of two others being by each section.

BRUSH HOLDER FOR DYNAMOS. W. M. Hand, St. Louis, Mo., 569,824. Filed Jan. 27, 1896.
Comprises a block having a socket, and a carbon having a neck fitting in the socket and held therein by solder.

ELECTRIC MOTOR. W. E. Freeman, Long Island City, N. Y., 569,866. Filed June 4, 1895.
Comprises a cylindrical shell constructed of two sections with a concentric cylindrical field magnet on the interior of the head of each of the sections, the field magnet constructed in an outline eccentric to the line of the exterior of the armature.

Electro-Metallurgy:

PLATING APPARATUS. J. T. Morrow, Great Falls, Mont., 569,722. Filed April 5, 1895.
The anode consists of a perforated receptacle filled with broken metal, a conducting shoe resting upon and above the scrap metal, and the flexible conductor leading to the shoe.

Lamps and Appurtenances:—

LOCKING ELECTRIC LAMP SOCKET. W. L. Taylor, East Liverpool, O., 569,727. Filed Feb. 21, 1896.
Means for automatically locking the lamp in its socket by inserting the lamp therein and a key by which alone the lamp can be released.

ILLUMINATED SIGN. O. L. Nason, New York, 569,764. Filed Dec. 14, 1895.
Comprises a stationary outer casing, in the sides of which the letters are cut, a revoluble cylinder placed within the casing, an electric motor at one end for revolving the cylinder, and an electric incandescent light within the cylinder.

ELECTRIC ARC LAMP. H. P. Davis, Pittsburg, Pa., 569,817. Filed Jan. 14, 1895.
Feed mechanism.

ELECTRIC ARC LAMP. H. P. Davis, Pittsburg, Pa., 569,818. Filed Jan. 14, 1895.
Similar to above.

ELECTRIC ARC LAMP. J. E. Morris, Chester, Pa., 569,881. Filed April 2, 1896.
Consists of an incandescent arc light to burn as a single lamp as distinguished from those burning in series.

Miscellaneous:—

APPARATUS FOR MEASURING CANDLE-POWER OF ARC LAMPS. E. J. Houston and A. E. Kennelly, Philadelphia, Pa., 569,643. Filed May 11, 1896.
Comprises two revolving mirrors and means for varying the intensity transmitted to the photometer according to a simple harmonic law.

Miscellaneous:

ELECTRIC APPARATUS FOR REGISTERING FIGURES AT DISTANCES. M. Arndt, Aix-la-Chapelle, Germany, 569,598. Filed Aug. 5, 1895.
A mechanism for recording the oscillations or strokes of a gas balance at a distance from the instrument.

ELECTRIC BAND. J. E. Luce, Minneapolis, Minn., 569,649. Filed Oct. 11, 1895.
Therapeutic band intended to be worn in the hat.

ELECTROLYTIC PROCESS OF BLEACHING AND REFINING. B. S and L. L. Summers, Chicago, Ill., 569,680. Filed Nov. 29, 1895.
Consists in first subjecting the material to the influence of a combined hydrate and fluoride bath, passing a current of electricity through the bath, and then subjecting the fibers to the influence of a fluoride bath, and passing a current of electricity through it.

ELECTRIC GAS LIGHTING BURNER. W. E. Cram, Boston, Mass., 569,785. Filed Jan. 29, 1896.
Comprises a movable electrode connected with the gas cock and arranged to co-operate with a fixed electrode adjacent to the tip of the burner.

ELECTRICALLY WELDED PIPE JOINT. A. H. and I. C. Matatall, Harrison, N. J., 569,836. Filed Aug. 26, 1895.
Consists in interiorly reaming out both sections of the pipe, until the inward bevel extends to the periphery of the pipe, subjecting the reamed out extremities to end-to-end pressure and, at the same time, to an electrical current.

LOCK WITH ELECTRIC SAFETY ATTACHMENT. A. J. Moulart, Paris, France, 569,882. Filed June 6, 1895.
Embodies two conducting half-sleeves arranged out of contact with each other, a split keyhole sleeve surrounding them, an insulating sleeve between the keyhole sleeve and the half-sleeve, and an electrically operated signaling device in circuit with the half-sleeves.

ELECTRIC MUFFLE OR HEATER. L. E. Custer, Dayton, O., 569,911. Filed May 31, 1895.
Designed for use by dentists in the manufacture of porcelain dental plates.

Railways and Appliances:—

ELECTRIC CONDUIT AND APPURTENANCES. M. Dickerson, Fort Wayne, Ind., 569,618. Filed Sept. 11, 1893.
A system of supporting yokes placed at intervals in combination with two central slot rails, two exterior track rails, and two side slot rails for railway use.

BALL-BEARING TROLLEY PULLEY. H. N. Gale, Bristol, Conn., 569,631. Filed July 14, 1896.

UNDER RUNNING TROLLEY. N. C. Bassett, Lynn, Mass., 569,738. Filed June 26, 1896.
Means to utilize the buffer spring for the purpose of assisting the lifting springs when the trolley is in its lowest position.

TROLLEY SUPPORT FOR TROLLEY CARS. O. Holz, Schenectady, N. Y., 569,756. Filed May 2, 1896.
Embodies a trolley arm with a spring supported trolley wheel.

TROLLEY SUPPORT FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, O., 569,772. Filed June 8, 1896.
Comprises a trolley pole, a series of springs connected at one end to the pole, and a second series of springs having sliding connection with the pole.

SINGLE WIRE ELECTRIC RAILWAY. J. C. Henry, Westfield, N. J., 569,827. Filed Aug. 27, 1892.
In combination with the car, an upright rotatable standard carrying a lateral trolley arm projecting beyond the side of the car and adapted to be swung from one side to the other.

TROLLEY FOR ELECTRIC RAILWAYS. H. A. Seymour, Washington, D. C., 569,889. Filed June 15, 1896.
Embodies an electromagnet device connected with the trolley wheel holder and constructed to force the trolley wheel against the conductor.

Switches, Cut-Outs, Etc:—

MULTIPLE FUSE CUT-OUT. G. T. Voorhees, Boston, Mass., 569,692. Filed Feb. 26, 1894.

FUSE FOR ELECTRIC CIRCUIT. C. F. Scott, Pittsburg, Pa., 569,803. Filed Dec. 3, 1895.
Comprises a strip of metal having a comparatively high degree of conductivity and reduced in size at a point intermediate its ends and a body of metal having a low melting point reinforcing the reduced portion.

SOCKET AND SWITCH FOR INCANDESCENT LAMPS, 569,931. Filed Oct. 15, 1895.
Details of construction.

AUTOMATIC CIRCUIT BREAKER AND CLOSER. C. C. Drake, Trenton, N. J., 569,960. Filed July 10, 1896.
Comprises a magnet and its armature, a swinging arm engaged with the armature, a normally wound motor having a dent in the path of the arm for releasing it and a device operated upon movement of the motor for restoring the arm.

Telephones:—

TELEPHONY. J. T. Williams, Brooklyn, N. Y., 569,807. Filed March 25, 1895.
Means to eliminate the necessity of the magneto-generating apparatus used for calling purposes.

TELEPHONE TRANSMITTER. H. C. Alexander, Bonham, Tex., 569,908. Filed Jan. 6, 1895.
Consists of a diaphragm, a spring supported carbon cell, furnished with a flange faced with soft material, and a filling of granulated electrode placed in the carbon cell.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCTOBER 27, 1896.

Alarms and Signals:—

ELECTRIC SIGNAL FOR STREET CAR CROSSINGS. C. A. Parrish, Jackson, Mich., 570,046. Filed Jan. 23, 1896.
Means to operate three signal circuits, all supplied with electric energy from the same source, and with the use of only one set of magnets controlling circuit makers.

SIGNAL APPARATUS. J. G. Schreuder, Edgewood Park, Pa., 570,062. Filed May 21, 1896.
A fluid pressure cylinder and piston for shifting the fulcrum of a lever connected to the signal and its operating means.

SAFETY APPARATUS FOR RAILWAY CROSSINGS. G. Gibbs, Milwaukee, Wis., 570,089. Filed Dec. 6, 1895.
Means to deprive the signal man of the control of the signals

and switches after he has once placd them to allow a train on one road to pass until it has cleared the crossing.

FIRE AND BURGLAR ALARM. B. J. Lowman, Bridgeport, Ala., 570,258. Filed Dec. 27, 1894.

Apparatus which may be applied to push buttons; having automatic means for pushing the button in case its tension wire is slackened by fire or the breaking into of a building.

Batteries, Primary:—

GALVANIC BATTERY. R. W. Gordon, New York, 570,013. Filed Oct. 14, 1895.

The combination of a jar, a permeable negative element suspended therein and adapted to contain a depolarizing agent, a positive element and insulating supports for said positive element secured to the walls of the negative element and projecting therefrom and interposed between and supporting the positive element.

Batteries, Secondary:—

END ELECTRODE FOR ELECTRIC POWER STORAGE BATTERIES. J. Langelaan, Cologne, Germany, 570,028. Filed Dec. 10, 1895.

An end plate having openings therein, and the plates intermediate the end section having unbroken surfaces.

MACHINES FOR MAKING GRIDS FOR SECONDARY BATTERY PLATES. Albert F. Madden, Newark, N. J., 570,224. Filed Jan. 11, 1896.

Comprises a blank holder with cutters on each side, means for reciprocating one of the parts in respect to the other, devices for rotating the cutters and mechanism for feeding the sets of cutters toward each other.

Conductors, Conduits and Insulators:—

INSULATOR. C. B. Martin and E. M. Hewlett, Schenectady, N. Y., 570,034. Filed Aug. 5, 1896.

Especially adapted to "third rail" use.

SECTION INSULATOR. L. McCarthy, Boston, Mass., 570,140. Filed Nov. 19, 1894.

Comprises side bars and end pieces to which the side bars are attached, the end pieces having means for securing the ends of section wires.

ART OF LINING METAL TUBES WITH FIBROUS MATERIAL. E. T. Greenfield, New York, 570,165. Filed March 2, 1896.

One or more forming dies for giving to a strip of fibrous material a tubular form; means for heating the forming die in combination with means for drawing the strip always in the same direction.

INSULATING JOINT FOR METAL OR ARMORED CONDUIT TUBES. E. T. Greenfield, New York, N. Y., 570,166. Filed April 6, 1896.

Comprises a collar which is interiorly screw threaded at its opposite ends and provided with an interior thimble of insulating material.

METALLIC JUNCTION BOX AND MEANS FOR UNITING METAL CONDUIT TUBES THERETO. E. T. Greenfield, New York, 570,167. Filed April 6, 1896.

Embodies an integral screw threaded neck, in combination with a tube adapted to fit snugly within the neck and a cone-shaped ring for gripping the tube and neck firmly together.

UNDERGROUND CONDUIT. E. T. Greenfield, New York, 570,168. Filed May 11, 1896.

Comprises a pair of conduit tubes having their ends located in close proximity to each other, in combination with an expansible insulating connecting tube provided with means for uniting the opposite ends to conduit tubes.

CONDUIT TUBE. E. T. Greenfield, New York, 570,169. Filed May 13, 1896.

Consists of a metal armor and an insulating lining, liquefiable under abnormal temperatures, in combination with an interior lining of a metal which will not fuse for such temperatures as will fuse or liquefy either lead or the insulating lining.

INSULATING JOINT FOR CONDUIT TUBES. E. T. Greenfield, New York, 570,170. Filed July 25, 1896.

Consists of two cup-shaped collars secured to the abutting ends of the conduit tubes, cup-shaped collars being provided with openings for admitting molten or liquid insulating material into the annular chamber which surrounds the ends of the adjoining tubes.

ART OF MAKING INTERIOR CONDUITS. E. Lavens, Brooklyn, N. Y., 570,256. Filed March 16, 1896.

Consists in inserting a tubular lining formed of soft, pliable and resilient insulating material within a protective armor, and then effecting close union of the armor and insulating lining by reducing the diameter of the external tube.

Distribution:—

SYSTEM OF DISTRIBUTION FOR ALTERNATING CURRENTS. C. S. Bradley, Avon, N. Y., 570,118. Filed April 3, 1895.

Does away with the necessity of maintaining a balance in polyphase systems.

Dynamos and Motors:—

ELECTRIC MOTOR. S. G. Brinkman, New York, 570,424. Filed June 27, 1895.

The armature is provided with a surrounding soft iron jacket.

Electro-Metallurgy:—

APPARATUS FOR PRODUCING WIRE BARS BY ELECTRO-DEPOSITION. J. B. Forsyth and C. R. Fletcher, Boston, Mass., 570,125. Filed June 27, 1892.

Employs a cathode composed of a cylinder, with a surface of conducting material and a strip of non-conducting material laid in a spiral groove, formed in the surface of the cylinder and extending out beyond the surface.

APPARATUS FOR ELECTROLYTIC DEPOSITION. W. De C. May, Niagara Falls, N. Y., 570,133. Filed Sept. 26, 1894.

Comprises a series of receptacles arranged vertically above one another, the bottom of each receptacle extending down into the immediately subjacent one, each of said receptacles being adapted to discharge its overflow into the next of the series.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. G. C. Pyle, Indianapolis, Ind., 570,053. Filed Jan. 27, 1896.

Comprises a gravity-fed upper electrode, a lower electrode, telescoping springs to support the electrode and feed it upward and a solenoid to regulate the arc.

ELECTRIC LIGHT FIXTURE. G. A. Schmidt, Brooklyn, N. Y., 570,411. Filed Dec. 10, 1895.

A canopy for electric light fixtures, comprising a stationary cup-shaped part of larger diameter than the stem of the fixture, and a shell adjustable longitudinally on the stationary part.

Measurement:—

WATT METER. G. Hummel, Munich, Germany, 570,019. Filed Jan. 30, 1895.

A form of electric motor intended especially for the driving of wattmeters.

Miscellaneous:—

VALVE CONTROLLING DEVICE. C. E. Ongley, New York, 570,-045. Filed Oct. 30, 1893.

Comprises a motor to operate valves, consisting of a cylinder having operative valves, and a piston rod and electromagnets in circuit having the armature secured to the valve stems.

ELECTRIC HEATER. E. P. Wetmore and C. E. Roehl, St. Joseph, Mo., 570,077. Filed May 1, 1895.

Comprises a converter having a hollow secondary conductor provided with a valve for feeding a liquid or gas into the conductor, and a circuit closer for opening and closing upon itself that portion of the secondary conductor which passes through the converter.

ELECTRICAL APPARATUS. J. F. Kelly, Pittsfield, Mass., 570,310. Filed June 23, 1896.

Employs iron having a high percentage of silicon for converter plates.

ELECTRIC ELEVATOR. F. B. Perkins, Boston, Mass., 570,410. Filed Sept. 7, 1895.

Automatic safety device.

Railways and Appliances:

TROLLEY FOR ELECTRIC RAILWAYS. W. M. Whiting, East Orange, N. J., 570,078. Filed May 6, 1895.

A trolley wheel mounted on a spring controlled pivoted arm.

ELECTRIC CAR MOTOR. C. S. Bradley, Avon, N. Y., 570,119. Filed March 30, 1896.

A car truck of an electric motor mounted upon a sleeve surrounding the axle, said sleeve being supported by the car wheels upon tangentially arranged springs.

ELECTRIC RAILWAY. A. Norman, Toronto, Canada, 570,328. Filed June 22, 1895.

The track is employed as a conduit for the main conductor.

TRACK CLEANER OR CURRENT COLLECTOR. William H. Roberts, Jr., Cumberland, Md., 570,339. Filed Jan. 27, 1896.

Comprises a brush mounted on a hollow casing inclosing a spring adapted to permit the vertical movement of the casing.

Regulation:—

ELECTRIC MOTOR REGULATION. W. A. Anthony, Newark, N. J., 569,989. Filed July 29, 1896.

Claim 2. In combination, a multipolar motor, having an odd number of pairs of poles, and means for varying the action of the coils which belong to diametrically opposite field magnet poles.

RHEOSTAT. A. C. Dinkey, Munhall, Pa., 570,009. Filed March 20, 1895.

Switches, Cut-Outs, Etc.:

ELECTRIC SWITCH. S. A. Stewart, Waltham, Mass., 570,068. Filed March 12, 1896.

Electromagnets are employed to break circuit when energized by an abnormal current.

SNAP SWITCH. A. B. Herrick, Jersey City, N. J., 570,172. Filed July 12, 1895.

Comprises a snap-blade having an engaging device on its rear edge, a spring connecting the free ends of the levers, and means carried by one of the levers to engage the lug when the main blade is thrown.

CIRCUIT BREAKER. A. J. Wurts, Pittsburg, Pa., 570,212. Filed Aug 31, 1895.

Adapted for use on electric cars.

ELECTRICALLY ACTUATED SWITCH MECHANISM. W. S. Browne, Brooklyn, N. Y., 570,373. Filed Dec. 5, 1895.

Adapted for use on electric railways.

AUTOMATIC LIGHTNING ARRESTER. G. P. Johnson, Gloversville, N. Y., 570,406. Filed Jan. 9, 1896.

Electromagnets are employed to break circuit when energized by an abnormal current.

CIRCUIT BREAKER. A. J. Wurts, Pittsburg, Pa., 570,415. Filed Aug. 31, 1895.

Adapted to be operated only after a suitable predetermined interval of time.

CIRCUIT INTERRUPTING DEVICE. A. J. Wurts, Pittsburg, Pa., 570,416. Filed Aug. 31, 1895.

Designed especially for multiphase circuits.

AUTOMATIC CIRCUIT BREAKER. A. J. Wurts, Pittsburg, Pa., 570,417. Filed Jan. 10, 1896.

Means to automatically open all the branches of a multiphase circuit whenever the current in any one of the branches exceeds a certain predetermined limit.

SWITCH FOR ELECTRIC CIRCUITS. A. J. Wurts, Pittsburg, Pa., 570,418. Filed May 8, 1896.

Comprises main contacts, auxiliary contacts in shunt thereto, and a single operating handle, the movable contacts having a limited movement independent of each other, and the shunt contacts having a retarding connection with a stationary part of the switch.

CIRCUIT BREAKER. A. J. Wurts, Pittsburg, Pa., 570,419. Filed May 29, 1896.

Adapted for use in high potential circuits.

Telegraphs:—

TELAUTOGRAPH. G. S. Tiffany, Highland Park, 570,072. Filed Jan. 6, 1896.

Means for operating two separate electromagnetic mechanisms over one line wire.

TELAUTOGRAPH. G. S. Tiffany, Highland Park, Ill., 570,112. Filed June 7, 1895.

Reversing mechanism for telautograph receiving instruments.

Telephones:—

ADJUSTABLE TELEPHONE TRANSMITTER. A. Gartner, Newark, N. J., 570,204. Filed Feb. 15, 1896.

A telescopic support for a telephone transmitter.

THE CORNMAN COMPANY, dealers in electrical apparatus, write us: "We value your paper very highly for the information which it contains as to new electric light plants, etc., and we enclose three dollars herewith for one year's subscription.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE MITCHELL TEMPERED COPPER CO.

The Mitchell Tempered Copper Company, of Corry, Pa., commenced operations June 1 last in producing and manufacturing light and heavy copper castings, employing only the Calumet Hecla ingot copper. The castings are free from blow holes and sound washings, are of even temper, and in the case of commutator bars are gauged to the thousandth part of an inch. The company have a motto: "Purity, Solidity and Durability," which typifies the character of their output.

The company is well backed financially and intends giving to the trade the best copper products which can be procured for tensile strength, conductivity and durability. Capt. Dan Mitchell, formerly of the Mitchell-Brandt Company, of Erie, is the superintendent. He has had wide experience in the casting and tempering of copper. The secretary and treasurer is J. G. Ruhl, an old time railroad man with a large acquaintance throughout the State.

PATTERSON, GOTTFRIED AND HUNTER.

A visit to the large establishment of Messrs. Patterson, Gottfried & Hunter, Limited, 146 Centre street, New York, would certainly be profitable from a business standpoint to buyers connected with electric light stations, power houses, isolated plants, factories, steam plants, etc. The prospective large buyer is usually taken in hand by the genial head of the firm, Mr. Gottfried. As a house carrying a general line of machinery metals, hardware, tools, and supplies, this firm is probably the largest of its kind in America. Enumerating a few specialties of interest to electrical and other buyers, we find: aluminum and phosphor-bronze, brass and copper wire, taps and dies, blowers and forges, ash cans and fire pails, shafting and belting, iron pulleys and hangers, Shaw's patent compression flange couplings, wire rope, wire cloth, brush copper, insulating fibre, Brown & Sharpe's fine tools, gear wheels, wire and cut nails, files and twist drills, bolts, self-hardening tool steel, etc., etc. Messrs. Patterson, Gottfried & Hunter, Limited, will take pleasure mailing an exhaustive catalogue of their goods on application.

CLIMAX GAS ENGINE CO.

The ideas as to the practicability of dynamos run in connection with gas engines vary largely, owing to the fact that there are quite a number of engines on the market which supposedly come up to the requirement, but after a fair test turn out to fall short of the mark. Among the exceptions however, are the gas engines manufactured by the Climax Engine Company, 31 Fulton street, New York, of which a descriptive article can be found in the issue of The Electrical Engineer of September 16. At a full load this firm guarantee a voltage fluctuation not exceeding two volts, and gas consumption not exceeding 50 cubic feet per kilowatt hour, equal to from sixteen to twenty-five full powered 16 candle-power lamps, according to wattage of lamp used. For generators for electric elevators and electric light dynamos, especially the latter, they guarantee a light that is practically steady, which certainly is an important factor to the purchaser. The Climax Gas Engine Company exhibit at their place of business their engine with ammeter, voltmeter and gas meter in full view, thus enabling the intending purchaser to make a thorough test before buying. This firm will take pleasure also in mailing a catalogue on application.

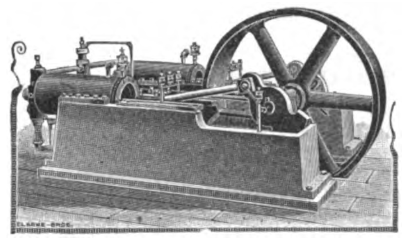
A "ROYAL" PLANT FOR JASPER, IND.

The Jasper, Ind., Electric Light Company, which was given a franchise recently, is putting in a 1,000 light dynamo built by the Royal Electric Company, with 5 miles of circuit. There will be an Erie engine of 125 horse-power, and a 100 horse-power Brownell boiler. The station is of brick and iron. Mr. Frank Joseph is president, and Mr. John L. Butz, secretary and treasurer. The plant is to be running before Christmas.

BRILL CARS IN BROOKLYN.

There have recently been placed on the De Kalb avenue line in Brooklyn, ten new cars built by the J. G. Brill Company, which are models in point of perfection both as to design and finish. They are twenty-five feet long, mounted on double trucks and are of such unusual width as to afford comfortable standing room for a number of persons sufficient to crowd to the extreme, a car of ordinary width. Double automatic sliding doors are employed, the clearance being so great as to make ingress or egress very easy. The lighting is accomplished by groups of incandescent lamps placed in the ceiling, and single lamps are ranged at intervals along the sides for the convenience of those desiring to read. These are provided with bell-shaped porcelain shades on brass fixtures and present a very ornamental appearance.

THE MILLER GAS ENGINE.



THERE has been installed and is now in successful operation in Chicago, a 50 horse-power double cylinder Miller gas engine, which is attracting a great deal of attention. This engine, shown in the accompanying engraving, is running an electric light plant and furnishes as steady light as can be obtained from central stations, and this result is accomplished without the intervention of expensive and cumbersome shafting and fly wheels to regulate the motion; and besides this is being done with the very moderate speed of 175 revolutions per minute.

The "Miller" gas engine does not operate on the "hit and miss" principle, but takes an impulse each revolution. It has a pneumatic governor with variable speed attachment and is exceedingly simple in construction. The machinery which operates the admission and exhaust valves and the igniters, is all in plain view of the operator, and contains very few parts.

The engine has cross heads for relieving the pistons and cylinders of undue wear. Gas bags, so objectionable to the insurance companies, are dispensed with. Although there are several of these engines in use in mills and factories, this is the first one installed for purely electrical purposes, and it is to be followed by another of same size, and a 37½ horse-power at once.

Electrical engineers who have seen this plant in operation express the belief that the "Miller" is a complete success and will have considerable influence on electric lighting, in isolated plants, in Chicago. The engine was sold and erected by J. M. Hayes, General Western Agent, 1119 Monadnock Block, Chicago.

E. H. KELLOGG & CO.'S ANTI-CORROSIVE AND ANTI-FRICTION LUBRICATING OILS.

There are two standard brands of oils, the Anti-Corrosive cylinder oil and the Anti-Friction machinery oil, which for years have been regarded in the electric and other fields throughout the world, as among the best in the market. These oils as well as the best grades of other lubricants are manufactured by the old and well known firm of E. H. Kellogg & Company, which established itself as far back as 1858, when the oil industry here was in its infancy. From the start their goods proved of such high merit as to cause a steady and increasing demand, so that now Messrs. E. H. Kellogg & Company claim they have more electric and water companies, etc., on their books than any other oil concern in the United States. The consumer will be astonished at the extremely small quantity of Anti-Corrosive cylinder oil required to give the most cleanly, cooling perfection of lubrication; allowing ease and regularity of motion, thus saving in power, fuel, wear and tear of machinery, and above all not losing sight of the fact that scarcely one-third of the quantity of oil is required, a large saving in expense. The same superiority of merit throughout prevails with the Anti-Friction machinery oil, which will run anything outside of a steam cylinder either high or low speed, from a jeweler's lathe to 100-ton planer. Messrs. Kellogg & Company also claim that it will compare almost three to one with lard or sperm oil. Buyers connected with electric light plants, electric light stations, railway power houses, etc., where a superior oil is of prime importance, especially for high speed engines and dynamos, will find it worth while to try these oils and lubricants, samples of which Messrs. E. H. Kellogg & Company will take pleasure in sending on application to their office and warehouse, 243 and 244 South street, New York. To facilitate their foreign business, their branch offices are established in London, Liverpool, Bremen, Hamburg, Bombay and Calcutta. Among the large number of consumers of their oils and lubricants may be men-

tioned: North German Lloyd Steamship Company, Bremen, Germany, for which they supply all oils and lubricants; Edison Electric Light Company, Columbus, O.; Ogdensburgh Electric Light and Power Company, Ogdensburgh, N. Y.; Terre Haute Electric Light and Power Company, Terre Haute, Ind.; Galveston City Railway Company, Galveston, Tex.; Ottawa Electric Light Company, Ottawa, Can.; Torrington Electric Light Company, Torrington, Conn.; Light, Heat and Power Company, New Albany, Ind.; New Orleans & Western Railway Company, New Orleans, La.; Springfield Light and Power Company, Springfield, O.; and many others.

SAMPLES AND DATA IN REGARD TO MICA MATERIALS.

A very interesting addition to existing data on insulating materials has recently been issued by the Mica Insulator Company, of New York, Chicago and London, in the form of a collection of samples of the various insulating materials which they manufacture, together with the results of actual tests on these various materials attached to each sample. Results are given on tests of the necessary voltage to break down a given thickness of each of these materials, and also on the specific insulation resistance. The figures given are the average of a large number of tests under various conditions, and are taken from the experiments of Herrick & Burke.

The Mica Insulator Compnay has realized that in order to fulfill all the requirements of insulation, it is necessary to manufacture various qualities and kinds of materials, as there is no one universal quality of insulation. Their samples cover a number of grades of "Micanite" insulation, consisting of a number of combinations of mica, mica and cloth, and mica and paper, of various degrees of flexibility. Also a number of grades of "Empire" insulation, which consists mainly of specially prepared and insulated cloth and paper. From a technical standpoint, the collection is very interesting, because it not only shows the various kinds of materials manufactured, but also is indicative of the advances that have been made in the preparation and manufacture of insulating materials, from a mechanical and an electrical standpoint, and the high degree of perfection that has been reached in this line of elctrical industry.

BARRUS & MONROE.

George H. Barrus and William S. Monroe announce that they have opened an office in The Rookery, Chicago, as mechanical and electrical engineers and experts. Mr. Barrus has been engaged in business as expert and consulting steam engineer for the past twenty years, with headquarters in Boston. The character of his work is widely known not only in the East, but also in the West. Mr. Monroe has been in business as mechanical and electrical engineer for the past two years, having an office in The Rookery, Chicago. He was formerly in the employ of Burnham & Root, architects, as mechanical engineer, and later he served as one of the principal assistant engineers at the World's Columbian Exposition. They are prepared to lay out and superintend the construction of steam and power plants, electric lighting and railway systems, steam heating plants, and ventilating systems, making the necessary preliminary estimates and preparing the plans and specifications required. They also inspect and test steam and electric plants for determining questions of fulfillment of contract and those of efficiency and economy of operation; besides undertaking to examine and test old plants with a view to reorganize the same and making them economical. They give personal attention to tests of boilers, engines and electric apparatus, to investigations of steam appliances, etc. They make estimates and valuations, also serve as expert witnesses in legal actions, and as referees. Their headquarters are in The Rookery.

NEW YORK NOTES.

NEW YORK CITY.—The Greater New York Signal Company has been formed by J. Fleischhauer, A. Lexow, C. K. Lexow and others, with a capital stock of $5,000.

THE BELL ELECTRIC COMPANY, of New York City, has been formed to deal in electrical appliances, by C. E. Potter, F. M. Bell, and J. R. Kein, with a capital stock of $150,000.

NEW YORK CITY.—The Greater New York Electric Light and Power Company has been formed by J. Fleischhauer, A. Lexow, C. K. Lexow, and others, with a capital stock of $50,000.

THE WALDEN ELECTRICAL SUPPLY COMPANY, Walden, N. Y., have recently bought out the electrical supply business of the Fowler Hardware Company and are in the market for electrical supplies of every description.

MR. THOMAS J. FAY, for a number of years the New York representative and late general manager of the C & C Electric Company, has severed his connection with that company and is about to join the ranks of consulting electrical engineers.

MR. HENRY MILLER, JR., late of the New York Carbon Works, has associated himself with the Phœnix Carbon Manufacturing Company, of St. Louis, and is making his headquarters at 136 Liberty street, New York, and will be pleased to welcome all his old friends at his new quarters.

MR. ELMER P. MORRIS, 36 Dey street, has accepted the agency for the East of the Automatic Circuit Breaker Company's goods, of Newaygo, Mich. He will carry a full line of samples of their various devices, and will be pleased to show them in operation to all interested who will call at his office.

THE ERICSSON TELEPHONE COMPANY, Home Life Insurance Building, New York, N. Y., are manufacturing a line of domestic instruments for long and short distance desk, warehouse, hotel and inter-communicating systems, etc. They will use the imported Ericsson Swedish coal grain microphone on all of their domestic instruments.

E. T. CALDWELL, Thirty-one East Seventeenth street, city, makes a specialty of designing only the most artistic and unique of combination electric and gas fixtures. Among the many places installed with Mr. Caldwell's work can be mentioned the Waldorf, Hotel Imperial, Hoffman House, new part of Savoy, Boston Public Library and many others. Mr. Caldwell manufactures a great many exclusive designs of combination gas and electric fixtures to special order.

NEW ENGLAND NOTES.

THE SESSIONS FOUNDRY COMPANY, of Bristol, Conn., have recently favored their friends with a handsome picture of their works. It is an excellent lithograph, well mounted, in an oak frame 24 x 40 inches, and makes a most desirable ornament to any office. This company is one of the largest in New England engaged in this field and supplies castings for all classes of work. They have paid particular attention to electrical business, and experience in this department enables them to meet all requirements of their patrons and guarantee the quality of their product.

JOHN M. FOX & COMPANY, electricians, Portland, Me., report construction business as very good. They have finished a 200 light electric plant at Hodsdon Bros'. shoe factory, Yarmouth, also Dr. Baker's six houses at Woodfords. Their contract for these called for electric light wiring throughout, wiring each house for electric bells and also the furnishing and putting in of the electric fixtures and shades, some 140 in number. Besides these, they have wired four other houses at Woodfords; the I. O. O. F. block, Saco; Mr. Walsh's residence at Lewiston; Mr. Chas. Payson's new block, Portland; put in additional lights on steamer Portland for the Portland Steam Packet Company, and several others, and have filled besides numerous contracts for bells, fixtures, etc.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY are meeting with large success as the General Western Agents for the Taunton Copper Manufacturing Compnay, and are now carrying a large and complete stock of their celebrated bare copper wire. They state that their customers seem to appreciate the advantage of having a complete stock of bare copper wire carried in Chicago from which they can draw in large or small quantities, as their needs demand.

MR. ALEX. CHURCHWARD, electric engineer of the Excelsior Electric Company, was a recent visitor to Chicago, where he superintended the installation of some new plants in which their handsome machines are to be used. Notwithstanding the constant cry of hard times during the past few months, Mr. R. J. Randolph, the energetic Western representative of this well known company, has closed up some nice new business for them.

THE STANLEY-CARLSON TELEPHONE MANUFACTURING COMPANY have removed from the Springer Building, 172 South Clinton street, Chicago, to more commodious quarters in the Dunn Building on Jackson and Clinton streets.

THE METROPOLITAN ROAD in Chicago, on October 9, "Chicago Day," when two great political parades took place, carried no fewer than 90,000 people in the 24 hours. The electric trains ran with the utmost regularity. Mr. W. E. Baker, the general manager, says that during the past six months, there has not been a single delay of a train or a single defect in the electrical apparatus.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. NOVEMBER 11, 1896. No. 445.

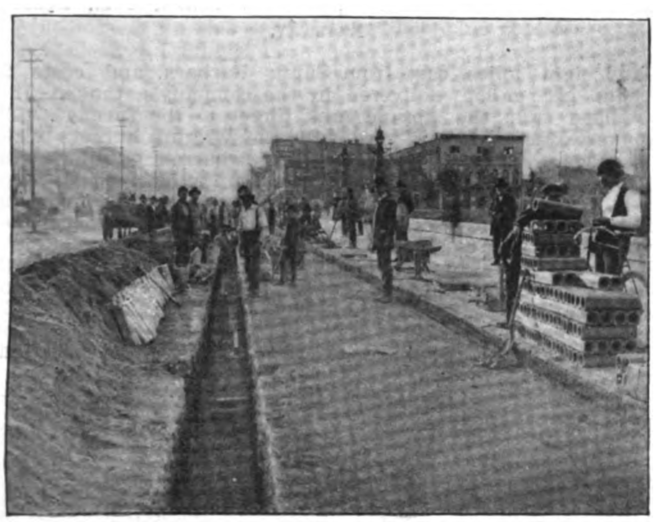
TELEPHONY AND TELEGRAPHY.

UNDERGROUND TELEPHONE WIRES IN INDIANAPOLIS.

SINCE the beginning of Fall the work of placing the telephone wires in Indianapolis underground has gone on apace and when completed the city will be comparatively rree from overhead wires, at least in the densely populated and business portion, including the vicinity of the State House.

The system in Indianapolis, when complete, will require nearly seven miles of trench in the streets and alleys. Over 260,000 feet of pipe will be laid and 95 manholes will intercept the conduit at various points.

The conduit used is the single duct vitrified clay pipe, manufactured by the H. B. Camp Company, at Greentown, Ohio. The pipe is carefully selected and cleaned out before being laid and after the conduit is finished and before the pavement is restored, the ducts are cleaned by a device consisting of, first, a length of iron pipe to gather up mortar and debris, then a spiral wire brush, following which is a steel flue scraper and another spiral iron brush. The sections vary from 200 to 600 feet in length. No difficulty has been found in previous work at Columbus and Toledo in drawing cable into a duct 600 feet long and over.

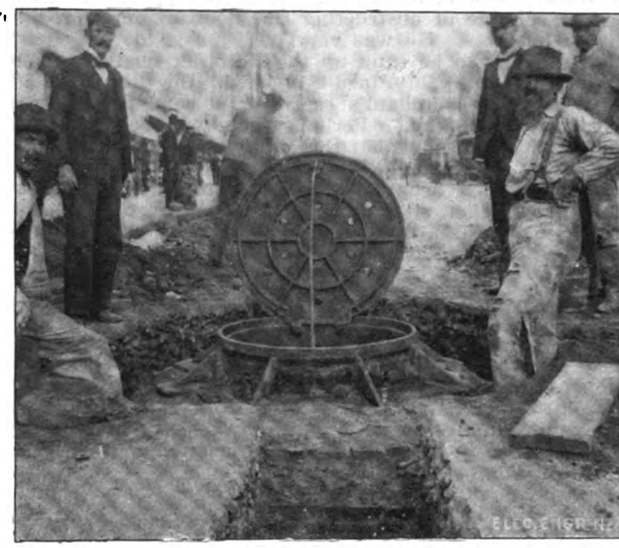


TELEPHONE CONDUIT IN FRONT OF INDIANA STATE CAPITOL.

Of course, where such long sections are used, it is necessary to have the pipe laid very carefully. All the grade lines are laid by transit and level and the pipe is put in with side lines from point to point, thus insuring an absolutely straight conduit from one manhole to the next. In places where straight runs cannot be obtained, owing to obstructions found in the ditch, extra manholes are placed so that if difficulty is found in drawing in cable, it will be but for a short length.

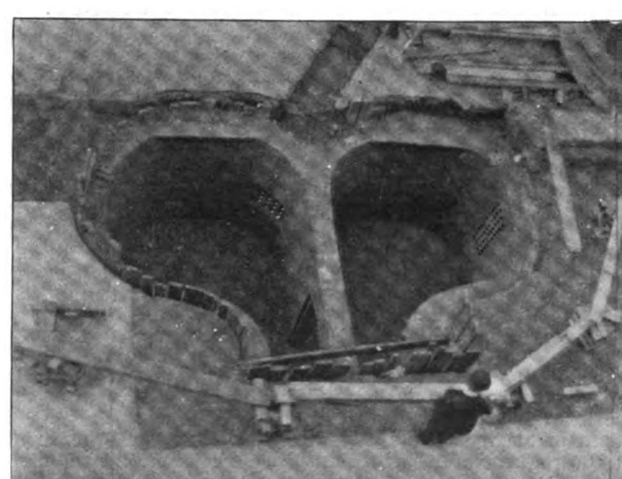
The manholes are of the well known barrel-shaped pattern, being similar to a longitudinal section of an ordinary barrel. They are large, varying in size from 5 to 8½ feet long. The office manhole is larger than this and is shown in one of the accompanying views.

The manhole cover used is of special design and is shown in the accompanying engraving. When the cover is raised, the end of the iron rod locks in place and holds the cover in an upright position to form a protection to the opening, thus saving the use of a tent or iron railing to be carried to the manhole in which work is done. This device of having the cover form the protection to the opening, has been used in several other systems, notably those in San Francisco and other Pacific coast points, with good success. As the manhole walls are built, bolts are set in at intervals near the top and to hold the cables on the walls, pieces of oak are imbedded in the floor of the manhole at one end and secured to these bolts at the other, iron cable supporters being then screwed to these wooden uprights at the proper distances.



MANHOLE WITH COVER RAISED.

It is intended to use 120-pair cable in the system, which can now be manufactured within a diameter of 2¼ inches. The distribution will be from poles set in the intercepting alleys, to which the cables will be run by laterals, these laterals being constructed of the vitrified clay pipe, but to carry the cable up the pole an iron pipe bend will be used, one end of which is bell-mouthed to fit against the clay pipe and the other end on the pole screw-threaded for jointure



BIRD'S EYE VIEW OF EXCHANGE MANHOLE.

with the iron pipe passing up the pole. Where necessary from the underground terminal poles, multiple aerial cable distribution will be used, especially in the business districts where it will be necessary to distribute from the cable at many points. This system is now successfully in operation in Toledo and to some extent in Columbus, Ohio.

Work was started on the last day of August and all the main runs are now practically finished. The first of November saw the main conduits completed and the majority of the laterals constructed. The shorter laterals are left until next spring.

The work is in charge of Mr. E. M. Jackson, Superintendent of Construction for the Central Union Telephone Company, who has a long experience in this class of work.

TRIAL BY TELEPHONE.

Neither Bell nor Edison ever dreamed of an application of the telephone that was made by a Montclair (N. J.) merchant last week. The merchant was cited to appear in court to answer a charge of obstructing the sidewalk in front of his place of business. He was very, very busy, too busy in fact to go to court, so he rang up the Recorder on the telephone and pleaded guilty. "Fined $10," said the Recorder. "All right," was the merchant's reply. "I'll send up the money right away. Good-by." Perhaps there will be more of this trial by telephone now that the Montclair man has blazed the way. Why not examine witnesses over the telephone, too? And let jurymen hear cases in the same manner. A busy merchant can then sit in his office with a telephone hood on his head and hear a divorce case, while he dictates letters to his typewriter or talks politics with his customers.

NEW YORK FRANCHISE WANTED FOR DRAWBAUGH TELEPHONE.

The Drawbaugh Telephone Company has filed its application for franchise with the New York Board of Electrical Control. J. R. Bartlett, president of the Drawbaugh company, is absolutely confident that a franchise will be granted, and that the new telephone and telegraph company will soon be in operation in New York City.

ORIGIN OF THE BEAUTIFUL WORD "TELEGRAM."

According to a San Francisco paper, it was E. Peshine Smith, the grandfather of Mrs. Rudyard Kipling, who originated the word "telegram." It would be injustice to the memory of the late Amos F. Learned, a Boston boy, remarks the "Boston Herald," to allow his claim to go unchallenged. Amos was the agent of the Boston Associated Press in New York, and it was in the hurry of sending dispatches during the war of the rebellion that the inspiration came to him to shorten the conventional "telegraphic dispatch," to "telegram." His claim was made on all occasions, and is not known to have ever been disputed before.

BELL TELEPHONE INSTRUMENT OUTPUT.

The statement of the Bell Telephone Company's instrument output for the month ended October 20 shows:

	1896.	1895.
Gross output	14,766	14,969
Returns	7,252	6,350
Net	7,514	8,664
Ten months:—		
Gross output	163,161	143,192
Returned	75,799	67,815
Net	87,362	75,377
Total number of instruments outstanding October 20, 1896	762,338	657,883

FREE MEDICAL TELEPHONES IN CHICAGO.

H. B. Stone, president of the Chicago Telephone Company, has issued orders authorizing physicians to use the automatic or pay telephones for communication with the health department free of charge. This privilege was brought about at the request of Health Commissioner Kerr and will be welcomed by physicians generally. The latter frequently discover in their professional rounds cases where the public health is endangered or persons whose condition is such that charity should be immediately extended them. Communication with the health department by telephone is simple and efficient, but the regular fee of 10 cents was an obstacle. The telephone company has, therefore, instructed its operators to allow doctors to communicate with the health department without the usual charge.

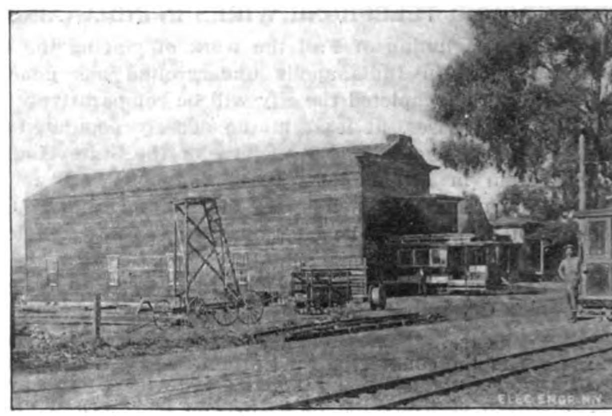
ELECTRIC TRANSPORTATION.

THE SANTA BARBARA ELECTRIC RAILROAD.

WITH OIL FUEL.

THAT quiet old mission town, Santa Barbara, California, succeeded in putting in operation an electric railway on October 1 last, after several years of agitation on the subject.

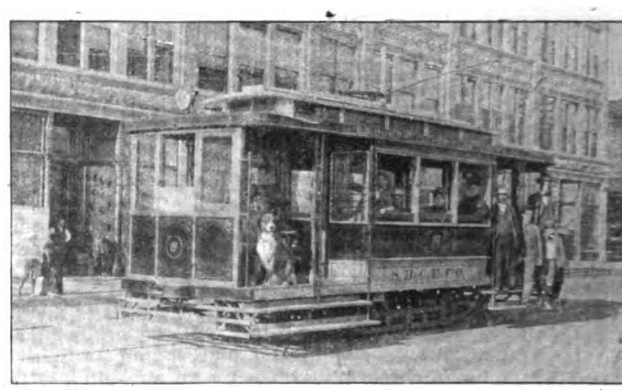
The new road extends diagonally from east to west across the city. The power plant and car house shown in our illustration are located near the freight depot of the Southern Pacific Railroad on a lot 225 x 230 feet with a private track connecting with the steam road for the purpose of handling fuel, etc. Crude oil is used for fuel, which is obtained from Sommer-



POWER HOUSE AND CAR BARNS, SANTA BARBARA, CAL., ELECTRIC RAILWAY.

land eight miles east from Santa Barbara, and costs 2¼ cents per gallon delivered in the company's tanks. It is pumped from the storage tank direct to the furnace. The compression system is used with the Wilgurs burners which atomize it thoroughly, using about 2 barrels of oil per car, per day, of 18 hours. A flowing well on the lot provides ample water for the boilers. The power plant is equipped with the Oil City Boiler Works boilers, Ideal engines and General Electric Company's 6-pole generators.

The cars, one of which we illustrate, were built by the California Car Company, of San Francisco, and are of the combination style originated in San Francisco and are peculiar to the Pacific coast; they have 28-foot bodies, 8 feet 4 inches wide and seat 32 people, with roomy aisles. The closed part



FIRST ELECTRIC CAR, SANTA BARBARA, CAL.

is seated with Hale & Kilburn's reversible cross seats and has double sliding doors with 3 feet 2 inches opening. On each platform are two longitudinal seats facing out with space ample for motorman between the backs. Each platform seats eight people. These seats are much sought after by visitors, smokers and young people.

The company have recently purchased all the equipment, properties and franchises of the Citizens Street Railway Company and the Santa Barbara Street Railway Company and now control all the street railway interests in the city with 50 year franchises for two desirable suburban lines.

Our illustration shows the first car run over the road by Miss Hattie K. Miller, daughter of the president of the road, and also the final trip of the old motive power which was retired on a pension.

The officers of the road are: C. W. D. Miller, president; A. Hope-Doeg, vice-president; H. S. Luster, secretary and treasurer.

LAST TRIP OF MULES OVER THE SANTA BARBARA ROAD.

CLEVELAND AND CHAGRIN FALLS ELECTRIC RAILROAD.

THE electric railway connecting Cleveland with Chagrin Falls, now rapidly nearing completion, combines several novel features worthy of extended description. The length of the road is about eighteen miles, and runs from Cleveland to Chagrin Falls by way of Warrensville. The cars start from the Cleveland Public Square and run over the old Woodland avenue and Kinsman street line, now a part of the Cleveland Street Railway system, to the terminus, which is four miles distant. It there starts on its own tracks and runs for a distance of eight miles on the pike road, where it enters its own private right of way which covers a distance of five miles.

The road throughout is built in accordance with the standard steam railway practice. The Cleveland and Chagrin Falls Company have a binding arrangement with the Cleveland City Railway Company by which after the cars enter Cleveland upon the local Electric Railway Company's line the C. & C. F. conductor and motorman leave the car and transfer it and its passengers to the local railway company's employés; these men to take the car to the Public Square, collecting from each passenger a five cent fare, and also on such traffic as they are able to pick up on the way. On the return trip from the Public Square they pick up passengers, either local or interurban and collect from each a five cent fare as before, and deliver the car to the C. & C. F. employés at the end of the line with its load of passengers. It is further arranged between these two companies that the C. & C. F. Company get a certain percentage of the fare receipts. After the car reaches the inter-urban part of the system, the registers will be taken down and the fare transaction made according to the ordinary steam railway custom.

There is to be but one power house which will be located nearly midway between the two terminals of the line. This power house is to be built of brick and of suitable dimensions for car house and repair shop.

The electrical equipment for the power house consists of two Walker dynamos, 150 kilowatt capacity each, direct connected to Russell & Company Corliss engines, and run at a speed of 150 r. p. m. These dynamos are of the latest and most approved design, multipolar type; the magnet yoke is of cast iron; the pole pieces are of soft iron laminated, and cast into the yoke. They have pole shoes of cast steel, which serve also to keep the magnet spools in position. The armatures are of the iron clad type; the plates are punched in segments from soft, well annealed iron, and are secured by dovetailed projections fitted into corresponding slots milled in the rim of the spider. The laminated core is divided into a number of sections separated by one-half inch air spaces, allowing ample circulation of air. The armature winding consists of flat copper ribbon formed into proper shape previous to assembling, and is entirely without joints except at the commutator leads. The coils are very thoroughly insulated and are held in place by phosphor bronze bands. The commutator is so constructed that the bars are held in place by a sectional clamp, so designed as to draw the bars firmly down onto the flat cylindrical surface of the spider. The current density in the carbon brushes at full load is a little less than 35 amperes per square inch.

The dynamos will be fitted with the latest and best design of brush holder. The engine adjustment, by means of a threaded spindle and hand wheel is used, with which the brushes need but a single adjustment in the correct position and they will run sparklessly at any load up to a heavy overload.

The switchboard will be of black enameled slate and highly polished. It will consist of two main panels and one feeder panel. On the two main panels will be one station voltmeter, 750 volts; two ammeters of 400 amperes capacity each; two automatic circuit breakers, 300 amperes each; two lightning arresters; two polished three-pole switches; two rheostats, etc. On the feeder panel there will be two ammeters, two circuit breakers, two lightning arresters and two single pole polished switches.

The car equipment will consist of two motors each, of the Walker well known No. 10 type, 50 horse-power each. These motors will embrace the latest inventions in spring suspension, the principal features of which have been fully described before in our columns.

These motors are made for severe service and high speed. The frame is made of soft steel, the armature of the softest annealed iron, and the insulation used is of mica and fuller board covered with waterproof paint and tested to 5,000 volts pressure in the shops. Another important feature of this motor is the arrangement of the bearings, which are entirely outside of the motor casing, and which, therefore, excludes the possibility of oil and grease getting inside the motor.

The new Walker trolley will be used on these cars, a description of which was given in The Electrical Engineer of July 8 and July 22.. The Walker controller of the latest and most improved design will be used, there being one controller for each car.

The power plant consists of two Russell four-valve automatic engines of 225 horse-power capacity each, built by Russell & Company, Massillon, Ohio. The cylinders are 17 inches diameter by 24 inches stroke, and the fly wheels are 92 inches diameter by 18 inches face, mounted on shafts 12 inches in diameter. The shafts run in self-oiling bearings. The engines run at 160 revolutions per minute, and they are built on lines suggested by a long and intimate experience with the requirements of electric railway duty. An iron base extends under engine and dynamo making a self-contained outfit for each unit.

The boilers are two in number of the tubular pattern, each 72 inches diameter and holding 70 4-inch tubes by 18 feet long, and built to carry a working steam pressure of 125 pounds. The arrangement of the power station is such that an increase can be made subsequently without disturbing the original installation.

There is to be one single acting feed pump, and one duplex feed pump, both of the Stillwell & Bierce pattern. There is also one 500 horse-power Stillwell & Bierce heater. The water for the boilers will be supplied from a pond made and owned by this company, and located in close proximity to the power house. The stack will be sixty inches in diameter, and eighty feet high.

The rolling stock will consist of five cars, the motors are Walker, two of which will be placed on each car, of a capacity of 50 horse-power each, and mounted one on each truck. Each car will be furnished with double trucks manufactured by the McGuire Company, of Chicago.

The cars are being built by the Pullman Palace Car Company, are vestibuled in the same manner as the general interurban car, and will be furnished with air brakes. The inside finishing of the cars will be in oak. The seats will be finished in rattan, and each car will be provided with the general accessories of the ordinary steam railway equipment.

The track construction consists of Carnegie 60-pound T-rails, except in the town of Chagrin Falls, where the girder rail will be used. The trolley wire will be No. 00 suspended on brackets, manufactured by the Ohio Brass Company.

It is expected that this road will be in operation within sixty days, when the company will begin to run its cars regularly every forty-five minutes.

TROLLEY TRAIN TIME TABLE. The Akron, Bedford and Cleveland Railroad, trolley system, issues a regular time table for its service, enumerating some 60 trains daily, and showing eleven stops between termini. The running time is about 2½ hours per trip. The cars connect with street car lines, by transfers, at each end.

THE MODERN POWER HOUSE.—III.

BY R. MC CULLOCH.

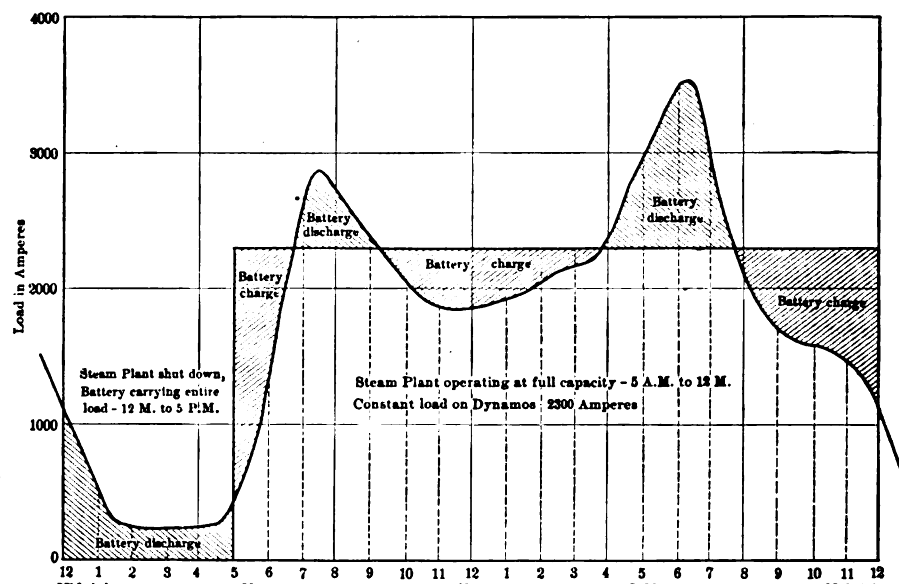
(Concluded.)

If readings be taken of the total output of the power house at stated intervals and then plotted, a load curve will be obtained similar to that shown in Fig. 1. A study of this will show a very small load through the night from 1:30 a. m. to 5:30 a. m., a sudden rise at this point to a maximum about 7:00 a. m., a lower load through the middle of the day, followed by another peak between 6:00 p. m. and 7:00 p. m., after which the load again suddenly drops. In order to accommodate the machinery to the varying load, the number of dynamos in circuit must constantly be changed, and even then it is almost impossible to suit the power at all times to the load, the dynamos running much of the time either overloaded or underloaded, which, of course, means a sacrifice of economy. In addition to the variation of load shown by the curve, there is a momentary fluctuation, due to the starting and stopping of cars, the violence of which decreases with the number of cars in service. It is proposed to remedy this variation and operate the dynamos under a steady load by means of a storage battery plant connected in parallel with the line, charged from the dynamos during the period of light load, and discharged into the line on the heavy call for power. The operation of the plant under these conditions is indicated in Fig. 1. Installations of this sort have been placed in several of the large electric light plants where they are operating with marked success, and there is no reason why they should not meet with the same degree of success in electric railway plants. By means of this auxiliary plant, the proper number of dynamos are run throughout the entire day at their full capacity and hence at their highest efficiency, the battery taking care of all eccentricities in the load, charging when the load is less than the capacity of the dynamos, and discharging when the load exceeds this. The steam plant may be shut down entirely during part of the night, leaving the battery to operate the road, and in case of a breakdown, the battery may be used to take care of the entire load for a short time. The battery is discharged through a booster dynamo, which is so designed that the compounding of the dynamos and the battery are the same. This arrangement is entirely automatic, so that no hand regulation is required. The efficiency of a battery operating under conditions of this kind will be guaranteed by the manufacturers to be greater than seventy-five per cent. and a maintenance of sixty per cent. on the first cost of the battery will be guaranteed. The great drawback to this system of operation is the large first cost of the battery which is about $100 per horse-power capacity figured on a two-hour discharge rate. A storage battery plant may also be used to increase the capacity of an existing power house and thus save the necessity of adding more machinery. There is another use to which a storage battery plant may be put which will, perhaps, appeal more strongly to the street railroad man. This is to install it as a substation to maintain the voltage at the end of long feeders, which are subject to fluctuating loads. In this case the batteries are charged from the distant power house and discharged into the trolley wire. The feeders from the power house to the storage batteries are figured only for the average load instead of the maximum load as would be necessary in case the line is fed directly from the power house. The economy in this installation depends very largely upon the difference in cost between the feeders in the two cases. Besides the question of economy, however, the substation will give the better service as the voltage will not fall and rise with the fluctuations of the load.

A number of power houses operating long lines are now equipped either with boosters or high voltage dynamos. Long lines usually have a booster constantly in circuit. This machine is automatic in its action and raises the voltage with every increase in the load. Some power houses operate a high voltage dynamo for use on sections which are subject to excessive loads. The feeder boards in this case are equipped with an extra bus bar, so that any section may be thrown on the high voltage machine.

While each individual engineer has his own ideas concerning power house construction, and while each road building a power house may purchase different apparatus, there is one general design which has been followed in many of the plants usually installed. It has been adopted by so many different engineers and in so many different places that it might almost be called the Modern Power House. The general features of this design are shown in Fig. 2. The engine room and boiler room are divided by a brick wall and under different roofs; both are brick buildings, covered with an iron truss roof; the boiler room is set on the grade of the street and the engine room ten or twelve feet above this grade, the space below the engine room being utilized for the piping and condensers; the engine and boilers are set at right angles to the wall between them, with the engines next to the boiler room, so that the piping is made as short as possible and the condensation lessened; the switchboard and feeder board are set on the opposite side of the room from the boiler room, so that the length of the dynamo cables is equalized as much as possible. The general features of this design may be summed up as follows: it is compact to save real estate and buildings and to minimize the number of employés and the superintendence. Large units are used for the sake of economy and to save the number of working parts. The building is as far as possible fireproof.

The electric part of the problem has been solved, temporarily at least, but the adoption of the multipolar, direct coupled dynamo. The large, slow speed engine has followed as a necessary consequence and the general direction of improvement in power house construction seems to be toward the use of devices to prevent the waste of heat and to minimise the labor required.

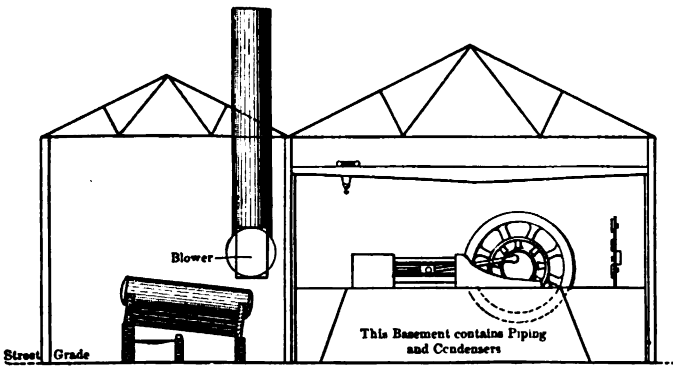


STORAGE BATTERY OPERATING IN PARALLEL WITH STREET RAILWAY PLANT.

Battery capacity—700 H.P. at two hour discharge rate.

FIG. 1.

There can be no more appropriate place to quote the proverb that cleanliness is next to godliness. An engine and dynamo room should be kept scrupulously clean. This is especially true in regard to the electrical devices, as a very small amount of grease and dirt in the wrong place will cause serious damage. Beyond the mere æsthetic consideration that cleanliness improves the looks of things, there is also the fact that a thorough cleaning amounts to a rigid inspection, and small leaks and defects are often discovered in this way which might otherwise pass unnoticed until they had become serious matters. It is to be regretted that this advice is not more generally followed, as there is more lost through dirty and greasy electrical devices, badly set valves, leaky steam joints, poor firing

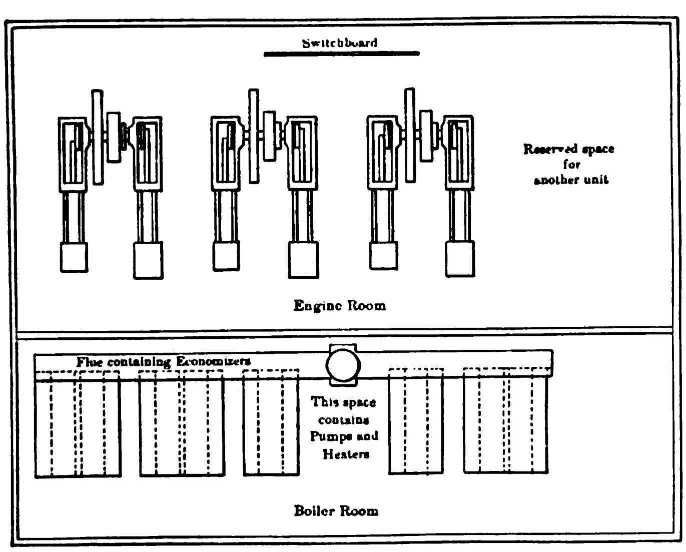


SECTIONAL ELEVATION.

FIG. 2.

and careless supervision than ever will be gained through the use of compound, condensing engines.

As a means of comparing different kinds of machinery, figures as to cost of operation have been collected from some of the large modern power houses, and their comparison reinforces what has just been stated, that less depends upon the refinements of the machinery, than upon the condition in which the apparatus is kept and upon the supervision to which it is subjected. Among those having the lowest cost of operation was a power house, equipped with direct coupled generators, but operating single cylinder, non-condensing engines, burning soft coal and using hand firing, while among those having the highest cost of operation are several power houses supplied with compound condensing engines, and burning anthracite coal. The lowest results are about three-quarters



GROUND PLAN

FIG. 3.

of a cent per kilowatt hour, some records running slightly below this, while the results from some of the large stations are as high as 1¼ cent per kilowatt hour. These figures include the cost of coal, water, supplies, repairs and all labor, but do not include anything for taxes, insurance, interest or depreciation. The cost of operation depends largely upon the cost of coal and upon the relation of the average load to the total capacity of the power house, the higher this ratio, the less being the cost of operation.

The modern electric railway power house, although it has been developed entirely within the past ten years represents the thought and the experience of many men. It has been developed carefully, detail by detail, until it is now a work both of reliability and efficiency. No one man and no one company can claim the credit for this achievement, but no class of men hold a stronger claim to recognition than the managers and owners of street railroad properties, who have ever been ready to encourage with their patronage each improvement, who have freely distributed the information gained by their experience, and who even in the most radical departures have ever acted with the courage of their convictions.

THE SELECTION AND MANAGEMENT OF EMPLOYEES.[1]

BY W. F. KELLY.

"It is a good divine that follows his own instructions; I can easier teach twenty what were good to be done than be one of twenty to follow mine own teaching."

An intelligent consideration of a man as an operative presupposes a knowledge of the conditions and environments under which the operative exists. What these conditions are, or seem to be, depends largely on the point of view. The public view it from one point, the employés from another, the manager from a third, and the stockholders or owners from still a fourth.

To the public mind a street railway is the visible, tangible property with which they are in daily contact, and the intangible, shadowy something which they call the management. The physical character of the property they judge of by observation. The management, they judge by the character of the employés with whom they are in daily contact. In a large system perhaps not one in 20,000 have ever seen the president. The mild-mannered, long-suffering manager, known and beloved by his friends and neighbors for his many kindly virtues, is too frequently in the public mind the embodiment of all that is selfish, cold-blooded and rapacious. If the common talk of the everyday world is to be believed, he delights in irritating and insulting the public, in the oppression and abuse of his employés, and is always endeavoring to rob the people or the city of their rights.

How does such an impression become current? Perhaps through the publication of his official acts and partly through the men employed on your cars. The employés reflect the character of the management, and whether we wish or not, the public consider the car employés with whom they are in daily contact, as representing their policy and attitude toward the public. We touch the public and have our measure taken largely through the men who man and operate your cars.

The pernicious idea that anybody can run a street car has in the past resulted in the employment of an army of careless, coarse and incompetent men, who through their ignorance, carelessness and incivility, have done more to bring street railways into public disfavor than all the official acts of its management and directory. The manufacturer selects his salesman not on account of his knowledge of his wares, but more largely on account of his ability to meet and treat courteously prospective customers. The management has time to discuss a fare register, sandbox or a truck, but has not an hour to give to the choosing of its public representatives. The selection of the human machine, which is far more important, more difficult to understand, more difficult to operate, causes the most trouble and expense, and fails most frequently, is too often entrusted to a man already burdened with many details.

The manager thinks it essential to have a competent, well paid man to purchase necessary supplies. If cars, motors or power station machinery are to be purchased, he gives it careful, personal attention, and calls to his aid skilled experts, in order that there be no error in so important a matter.

Every employé of a street railway should be considered as an agent with possibilities of harm to his employer. It is not enough that he is intelligent, sober and industrious. He should be of good judgment and sound thinking, and neither communicative, socialistic or anarchistic in his views; not discontented and at cross purposes with the whole social order, but of cheerful disposition and content to make the best of life as he finds it.

The physical and intellectual qualities of the applicant should both receive careful consideration; well-bred, sound, vigorous men, with a fair common school education, can be readily secured, and the wideawake management should be satisfied with nothing less. In order to exclude many undesirable applicants, a high standard of physical qualifications should be established and adhered to rigidly. Certain previous occupa-

[1] Read before the Am. St. Ry. Assoc., St. Louis, Oct. 19-23, 1896. —Abstract.

tions are considered as disqualifying. Policemen, firemen, steam railroad employés, political appointees are as a class undesirable. There may be individual exceptions, but they are rare.

Friends or relatives of the directory or other company officials, relatives or political friends of city officials, brothers or near relatives of present employés are frequently inefficient and troublesome. They are a dead weight on the neck of the active manager and no matter how excellent the reason, every dismissal involves an explanation, and frequently ill-feeling on the part of those who have been favored by having their friends appointed. Fitness should be the sole standard for securing a position. The manager should have no favorite or relatives on his force, and should be wholly untrammeled by his directory or superior officers. Either he is large enough to discharge the duties of his office without suggestion as to details, or else the property needs a new manager.

In large systems the duties of general manager are so numerous that he thinks it impossible to devote his time to the employment and discharge of conductors and motormen. Then by all means relieve him of many of these. Plenty of competent men can be found to purchase materials, jolly the council, place insurance, adjust damage claims, etc., but few men have the clear judgment and broad-mindedness to select the best class of men for their service and to deal fairly, firmly and kindly with their faults and failures.

No class of public service is more exacting than that of the street car employé. In no other business do the public get so much for their money and grumble so much because they don't get more. In no other business is the employé so much the personal representative of his employer as in this. What do we expect and require of him? That he always be prompt in reporting for duty; always quick and accurate in the various details of his business; honest, sober, intelligent, trustworthy, clean, courteous, smiling, patient, good-natured, never weary, always ready to help everybody, always obedient to several dozen or hundred rules; in fact, a model of all the virtues for $2 a day. Desiring all these, there are some managers who require yet more. I have in mind one prominent city road, in which nearly all the employés are of one religious belief, and others find it difficult to secure employment. Another, in which all employés are opposed to this belief; and yet another in which they are almost wholly of foreign birth or parentage. In the first two cases, this condition arises largely from the personal prejudice of the manager, and in the other through a mistaken notion of economy. It is fair to assume that neither of these managers are of that broad gauge type which places high character and efficient service above political or religious creed.

Granting that there has been careful and intelligent selection it is equally important that there be wise and considerate management.

The electric motor and the cable have ushered in the new era of city surface transportation. New blood and new capital entered the field, but many of the old customs and old employés remained. The change from animal to mechanical traction has been swift and startling. In many places the horse car is but a memory and the mule driver is an extinct species. Track, cars, and power station up to date, but the method and management of the men who operate the cars is that of the past decade.

It is conceded that a different type of man is necessary, and on various systems, there has been a noticeable change since the horse car days. True to natural law, the fittest have survived and a superior class of men now operate the cars. There has not been on the part of managers in all cases so marked an improvement in the modification and amelioration of various harsh practices. It is urged that the more intelligent, superior type of man is deserving of better treatment than the mule whacker of ten or twenty years ago. Frequent and severe punishment for petty offenses should be abolished and a code of rules established worthy of the men and the business they represent. The almost universal practice in punishing minor offenses is to "lay off" the employé from one to ten days, without pay, which is, in effect, a fine of from two to twenty dollars. The man is soured, his family suffers from the loss of earnings, and if the man happens to be a conductor it is not surprising if he tries to get even by nipping fares. The practice is still adhered to by many railway companies, and the offenses which the punishment is supposed to correct still continue. Such a practice would not be countenanced in a manufactory, a store or in commercial affairs; why should it be on street railways? If the man is valuable enough to be retained in service, why should his family suffer the loss of his wages? If the man were permitted to continue at his work and one-half the amount he would lose by laying off were assessed as a cash fine, the practice would be condemned in unmeasured terms, both by the press and an indignant public. If employés are not amenable to reprimand administered in a proper way, then they have not your welfare at heart, and should be dispensed with altogether. An entry, together with date, should be kept of all occurrences connected with every employé. It should show his absence from duty, whether from sickness or other causes, his various little lapses from duty, disobedience or neglect of orders, etc. This record should be frequently examined by the manager, and when it is evident that the man is making no improvement, replace him at once without waiting for "something to happen."

All foremen and sub-foremen should be impressed with the idea that all men under their charge should be treated in a gentlemanly manner and with the utmost fairness; that there shall be no favoritism in recommending men for promotion or in shielding them from punishment. Much depends on the integrity and good judgment of the division foreman. It is, therefore, highly essential that there be no mistake in selecting men for these positions. If they are not active, loyal and interested in their work, discipline will be lax and unsatisfactory service the result.

Employés should not be censured for light or trivial causes or on ex-parte testimony. Reprimand should be kind but pointed and manly, and never in public or in the presence of his fellows. Deal fairly and justly with every man and teach the man to feel that his case will receive careful, unbiased consideration, and that for similar offenses the same and certain punishment will follow in all cases.

Drinking on duty, drunkenness, frequenting saloons or gambling rooms, or association with loose women are all inimical to good service, and merit dismissal.

Revise your rule book and eliminate all useless and harsh rules and insist on a strict observance of the remainder. Study it and see if many old customs should not be abolished and new ones inaugurated. Put yourself in the employé's place and see how many of them you think are necessary in order to secure efficient service.

A number of large railway companies have in recent years furnished comfortable and attractive waiting rooms for their men, with reading room, lavatory, etc. This is neither charity nor generosity. It is a plain business proposition that the company will obtain better and more satisfactory service if the men have cosy and attractive quarters about the car houses. The manager too frequently thinks that when he has done all this, his men have no cause for complaint and that they are ungrateful and unappreciative. Let him look beneath the surface and discover the cause of the irritation. He will probably discover that somebody or something is not receiving fair play. That there is some discrimination in promotion, punishment, hours of labor, etc. The grievance may be only imaginary, but until it is considered and adjusted it creates grumbling and discontent as surely as a real one. To obtain the best service there must be a feeling that the manager has a personal interest in the welfare and success of his men. Prizes for good conduct and satisfactory service, beneficial organizations, reading and recreation rooms are all helpful and in the right direction; but courteous and manly treatment, and a kind word now and then smooth away the irritations of an exacting service more than all else. The man must feel that you respect his manhood, integrity and fidelity; that aside from his service as an employé you have a human interest in his success as a man. He has a right to feel that years of right living and faithful service entitle him to your confidence and that his good character should shield him from evil report.

Improved conditions, shorter hours of labor and better wages have all contributed to make street railway service more desirable and attractive to a high class of labor. Formerly it was considered that street railway men were necessarily a shifting, thriftless class, whose term of service was of brief duration. Street railway managers seemed to think it a part of the daily programme to discharge somebody or employ somebody—anybody—in his place. Men looked upon it as a makeshift job—a chance to pick up a few dollars while waiting for something better to turn up. The result was a miscellaneous aggregation of men with no higher interest in the welfare of their employer beyond receiving their wages. Happily this condition is fast passing away, and the best street railway systems to-day are those which have given most care and attention to the selection and treatment of their men.

We may never reach that ideal condition where every man is capable, honest and trustworthy. It is none the less worth striving for, and the manager who most nearly approaches it has within his grasp the highest elements of success. With the whole body of employés loyal, faithful, intelligent and devoted to their duty, gross earnings would be increased and operating expenses diminished, personal injury claims be reduced to a minimum, secret service agents no longer necessary, the occupation of the labor agitator gone, the kicker silenced and that peace of mind of which the general manager now only dreams, will become a reality.

THE KENSINGTON SPRINKLING CAR.

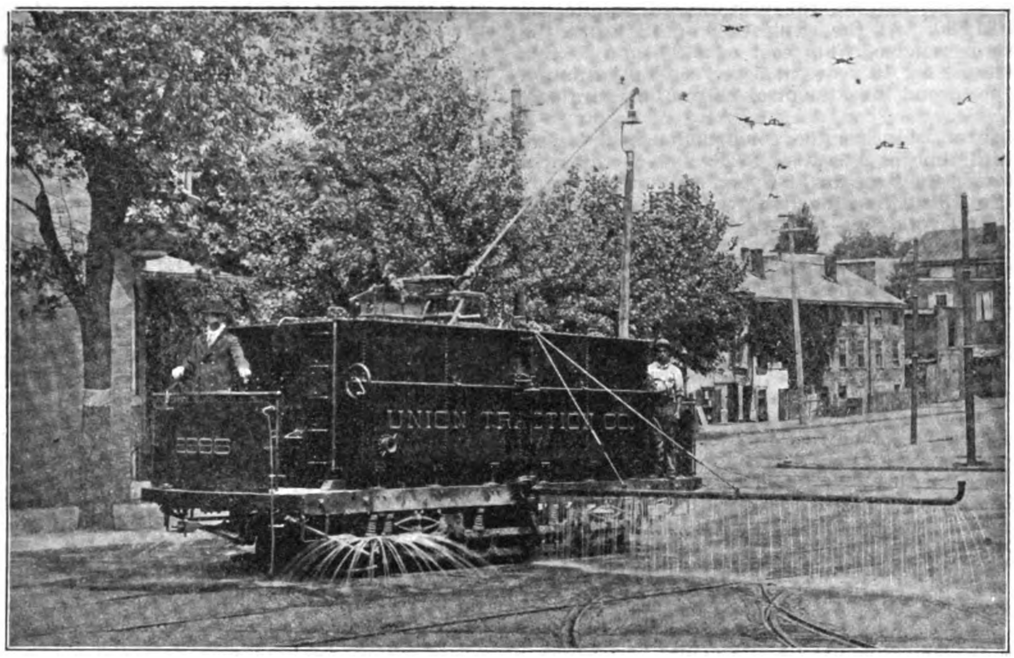
THE sprinkling car shown in the accompanying engraving is built by the Kensington Engine Works, Limited., Philadelphia, Pa., and combines in its design and construction a number of new and attractive features. It is provided with a tank 16 feet long, having a capacity of 3,000 gallons; enough, it has been demonstrated, to effectually sprinkle about three miles of road.

The tank is made of plate steel and provided with six baffle plates extending from side to side, making seven compartments, communicating with each other by triangular openings in the corners of the plates, preventing swash of the water in case of violent stopping of the car. Manholes and openings for filling the tank conveniently and quickly are at the top, and there are two hose connections arranged at the ends on opposite sides for filling from plugs when that is desired. Ladders from front and rear platform give easy access to the top of the tank and float tell-tales at each end indicate the height of water carried at all times.

To sprinkle over the track and within a short distance upon each side, perforated pipes are provided at both ends of the car; these curve outward and return to the side of the truck. To sprinkle the street a considerable distance on both sides of the track, two swinging arms are provided with perforated pipes carried on cranes that swing in a half circle, with a radius of about 18 feet, making a total width of road sprinkled of over 45 feet. These arms are worked from either platform, by hand wheels actuating a worm engaging wheel on the post of the crane. In case of necessity, these arms can be swung against the car in ten seconds, and are entirely out of the way.

The water valves are of a quick-opening design and are placed beneath the car. They are worked by levers on the car platform, so that control of the entire apparatus can be had from both platforms. The Kensington sprinkling car is mounted upon the standard trucks and driven by the usual motors and electrical attachments.

The Union Traction Company has equipped its entire lines in Philadelphia with these cars, using eleven for the work.



THE KENSINGTON SPRINKLING CAR.

MODERN OVERHEAD CONSTRUCTION.[1]—I.

BY BENJAMIN WILLARD.

IN the equipment of electrical street railways the item of overhead construction is a very important one, and one susceptible of many ideas. There are many different methods and kinds of materials used on overhead work, all of which would go to make up practical and modern construction, but as a matter of fact there are hardly any two installations which are near alike. The reason for such a variety of construction is naturally the result of engineers' ideas, conditions and opinions relative to the merits of different manufactured parts. It is hardly possible to standardize an methods and appliances in such a way as to meet the general approval of different engineers, as the requirements vary with local conditions, and what may be found practical in one locality may be found faulty in another.

My ideas relative to what is necessary for practical modern construction will undoubtedly differ in many respects from the opinions of others, and in some instances may be found not practical, but experience has proven to me many important features to be observed in modern construction, and I can only submit what in my opinion and during my experience I have found to be substantially practical.

Trolley line construction can be erected in various ways and still conform to good practice, one difference being in the kind and cost of poles to be erected. There are various requirements governing the selection and kind of poles to be used which determine an important factor in the first cost. Municipal requirements may compel you to erect steel or wood poles, or you may be allowed to make your own selection. In the first instance the price is fixed and you have only one thing to do; in the second instance you have opportunities which are left for your own discretion. The steel pole presents a neat and attractive appearance, also takes up a small amount of space, which are the chief points in its favor. The insulating qualities are not as good as with the wood pole, and although I am not prepared to say positively as to its lasting qualities, I have made some observations on deterioration of wrought iron columns that have been in the ground for several years, and estimating that this deterioration would take effect in the same proportion on steel poles, I am convinced that in a moist climate a limit on the practical life of such poles would not be over thirty years. While I am not strictly an advocate of wood poles, I am of the belief that from a practical and financial standpoint, wood poles should be used in many instances.

Through the business sections of cities steel poles are in some respects better, as they are not affected by being wilfully or accidentally mutilated. In suburban or resident districts the wood poles when properly dimensioned answer every purpose, and appear fully as well as the steel poles. A heart pine or cedar pole will, if properly selected and kept painted, last in some climates twenty years. This is a known fact from observation on poles that are now in sound condition after having been erected for that length of time.

Suppose we select New Orleans as a suitable location to build a road and base our estimates on cost of material there. The cost of steel poles would be greater than in many northern cities owing to freight rates and distance from the manufacturers of such poles. Wood poles can be furnished for less in New Orleans owing to their near production, so that I think

[1] Read before the American St. R'way Assoc.—Abstract.

an estimate covering cost at that point would be a fitting proposition elsewhere.

Steel poles for one mile of span wire construction, 104 poles at $15 each, would cost $1,560, and assuming their life to be 30 years, the interest on your investment for 30 years at 5 per cent. per annum would be $2,340 or a total first cost and interest of $3,900. The setting of steel poles necessitates the use of concrete which is an expense to be figured over the cost of wood pole setting, so we must figure at least the cost of such material and labor which would be $4.50 per pole, or $468 per mile, figured with interest for 30 years at 5 per cent. per annum, would be $1,170, or a total for interest and first cost of material and labor of $5,070, which is to be considered against the cost of one mile of wood pole construction covering the same period.

Assuming the life of wood heart pine poles to be 12 years (instead of 20 years) I will base a comparative propositon on that basis, taking the interest on each investment and carry it through to the expiration of 30 years. Wood heart pine poles for one mile of span wire construction, 104 poles to the mile at $4.50 each, would cost $468, also suitable labor and material for erecting at $2.50 per pole, $260, or a total first cost of $728; to this must be added interest for 30 years at 5 per cent. per annum, $1,092, making the first investment at the end of 30 years $1,820. At the expiration of 12 years the construction must be renewed at a cost of $728, and to this must be added interest for 10 years at 5 per cent. per annum, $655.20, making the second investment at end of 30 years cost $1,383.20.

At the expiration of 24 years the construction will be renewed for the third time at a cost of $728, and to this will be added the interest for 6 years at 5 per cent. per annum, $218.40, making the third investment at the end of 30 years cost $946.40, a grand total for wood pole construction of $4,149.60. The difference between total costs of steel and wood pole construction for a period of 30 years would be $920.40 per mile, which would be more than a liberal allowance for changing span wires and other work, but assuming it would take this amount we would stand even at the end of 30 years and still have 6 years more paid for on wood pole construction.

If steel span poles are used, I would recommend for the average span of 40 feet a pole weighing about 700 pounds, made in two parts. The lower section to be constructed of 6 inches extra heavy, and the upper section of 5 inches standard steel pipe swaged at the joint for a distance of 18 inches. Such a pole to be 28 feet long, 18 feet for the lower and 10 feet for the upper section, and provided with a cast iron and wood pole top for the attachment of the span wires. Such poles should be provided with a wood filling to fit the bottom of the lower half to prevent it from sinking, and should be set 6 feet in the ground with a rake of 10 inches from the perpendicular to allow for being straightened when under strain. The average size of hole to be dug would be 20 inches in diameter with a depth of little over 6 feet, requiring (after the pole is inserted) a mixture of about one-half cubic yard of concrete composed of one part of Portland cement, two parts of sharp sand, and four parts of broken rock. The cement should be given at least three days in order to set firmly before attaching the span wires. Whenever it is practical to allow poles to bear against the curbing this should be taken advantage of, as it affords an efficient stay to assist the pole in resisting the strain. Should it not be possible to secure use of the curb (or paving) a good sized rock having a bearing surface of about one square foot would assist very much, and keep the pressure from cracking the cement.

If wood poles are used, where it is necessary to make neat appearing and substantial construction, I would recommend for the average span of 40 feet a long leaf yellow pine pole dressed and chamfered, 30 feet long, sawed square, 11 in. x 11 in. at the base, and 7 in. x 7 in. at the point, free from sap, rot or knots, and corners evenly chamfered 1¼ in., beginning at a point 14 feet from the base, and terminating in an octagonal form and roofed evenly for a space of 3 inches.

In setting wood poles where concrete is not used (and I do not consider it necessary) a great deal depends upon the soil encountered. Whereas it is necessary to use very little prepared material for filling in some localities, it will take a quantity in others, so I will mention what would be required in a soil of medium clay and character which would probably meet the average condition. Poles should be set 6 feet in the ground with a rake of 12 in. from the perpendicular to allow for being straightened when under strain, and the hole should be dug to a vertical depth of 6 feet (or more, if necessary, to allow the pole to stand a given height above the track) in the ground, and should be about 2 feet square at the top, and not less than 18 inches at the bottom. Where it is practical to allow poles to bear against the curbing (or paving) this should be taken advantage of, and it will not be necessary to use other material near the surface as in iron pole construction, but it will be necessary to place a substantial bearing at the heel to prevent the pole from pressing through the earth; for this purpose a small quantity of coarse broken stone or brick bats will answer every purpose, and where this is not easily obtainable, and the earth is soft, a piece of plank 12 in. wide by 3 in. thick, 4 feet long sharpened and driven into the earth to a depth of about 2 feet at the back and base of the pole will give good results.

Whenever it is necessary to erect poles in the absence of substantial material at the surface, such as paving or curbing, I would recommend that the base of the pole be well rammed with broken rock for a distance of 18 inches, taking pains that the greater quantity is placed at the back where the pressure is greatest and leaving a small quantity in front where no pressure takes place. The space to within 20 inches of the top may be filled with earth taken from the hole and well rammed. To prevent the pole from yielding at the surface a breast plank of oak (or cypress) timber 3 in. x 12 in. x 6 feet should be placed and spiked in front and at right angles to the pole about 8 inches under the surface of the ground, which would make a suitable bearing surface, and resist the span wire strain. About 20 inches from the top of the hole and in front of the breast plank should be filled and well rammed with the same material that is used at the base of the pole. The necessary quantity of broken rock required would be about 2-10 of a cubic yard to the pole.

Poles of wood or steel, which may be used for holding strains at curves, should necessarily be heavier than those used for straight line construction and should also be set at greater depth in the ground. Steel poles of proper dimensions for curve construction would be made in two joints and constructed on the same principle as the straight line pole, excepting with heavier dimensions of pipe. A steel pole for curve construction should be 29 feet long, made of 6-in. and 7-in. extra heavy pipe, the larger section to be 19 feet long, and the smaller section to be 10 feet long and made to weigh 1,050 pounds. Such poles should be set 7 feet in the ground, and raked 10 inches from the perpendicular in a direction radiating from central point of curve where strain is required. The filling necessary would be the same as specified for straight line iron pole construction.

Wood poles for curve construction would be made similar to those specified heretofore for straight line construction, excepting dimensions of such poles should be 31 feet long by 14 in. x 14 in. at the butt, 9 in. x 9 in. at the top, chamfered from a point 14 feet from the base to the point terminating in an octagonal form and roofed evenly for a space of 3 inches. Such poles should be set 7 feet in the ground and raked 12 inches from the perpendicular in a direction radiating from the center of curvature where strain is required. The hole should then be entirely filled with about 7-10 of a cubic yard of broken rock and well rammed.

ROENTGEN RAYS.

ROENTGEN RAY APPARATUS.—THE CURRENT INTERRUPTER.

BY PROF. W. M. STINE.

WHEN the great Spottiswoode induction coil was constructed, very considerable difficulty was experienced in producing regularity and sharpness of the interruptions of the primary current. It seems singular that during the twenty years which have elapsed, no material progress has been made in either the invention or refinement of mechanical or magnetic breaks. Except to a few investigators, the problem has not been a pressing one. This condition is now changed, and the very widespread use of Röntgen tubes necessitates new and improved methods for interrupting the exciting current.

As introductory, a number of general considerations claim attention. For the maximum production of Röntgen rays, a spark shorter than popularly supposed seems best adapted, but this spark must be a thick one, or otherwise the secondary current must have considerable intensity. This occurs when there is the most complete resonance in the primary circuit. The condition of resonance results from the proper proportioning between the capacity of the condenser, the exciting current and the time rate of interruption of the exciting current. When the primary circuit is broken, the e. m. f. of self-induction forces a spark across the gap. If the contacts readily volatilize, the vapor formed by the arcing reduces the resistance of the air gap and delays the decay of the exciting current.

Another important consideration is the goodness of the contacts. Using low e. m. f. for exciting the primary, the resistance of a poor contact very materially cuts down the exciting current.

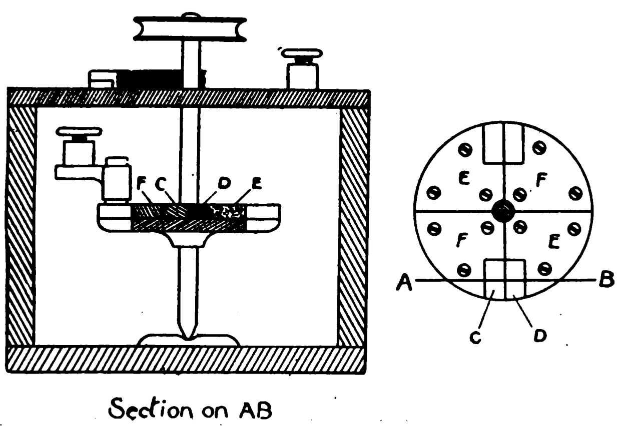
The problem presented, then, is to prevent arcing at the contacts and to insure a firm electrical contact of high conductivity.

Interrupters may be broadly divided into two classes,—mechanical and electromagnetic. We may now proceed to an examination of particular types.

Mechanical Interrupters.—(1) A form much used consists of a number of radially projecting lugs attached to a shaft rotated by a motor. The circuit is completed by a spring strap struck by the projecting teeth, both contact parts being usually of copper. Vicious arcing occurs and the tendency has been to attempt to suppress this by adding condensers across the gap. The result is that the coil is thrown out of resonance, which, added to the prolongation of the current by the arc, produces a thin spark. The spark also varies in length, due to the varying resistance of the contact by the vibrations of the spring.

(2) A modification of this type is made by filling up the gaps between the contact teeth with some non-conductor, making a smooth periphery. The vibration of the spring is prevented, but the arcing is rather increased, and a more uncertain action of the coil results. Through constant arcing the periphery soon becomes indented, and the spring contact is impaired.

(3) To this type have been added two devices for lessening the arc. One means is to direct a jet of air on the contacts



Figs. 1 and 2.—Under Water Break Wheel for X-Ray Coils.

at the instant of interruption, as is done in the Thomson-Houston arc dynamo. This is fairly successful. Another method employs an electromagnet for "blowing out" the arc. This seems even more efficient than the air jet. With both methods, however, the spark is thin, and they require nearly double the exciting e. m. f. really necessary to operate the coil. As a result, the spark length is very uncertain, and there occurs an occasional spark of extremely high voltage which is very liable to puncture the tubes.

(4) The water break, which will be noticed below.

Electromagnetic Interrupters.—(5) The mercury break is perhaps the most powerful of this class. A pin actuated by the magnetism of the core of the coil dips into a vessel of mercury. Upon its withdrwal a violent arc occurs, vaporizing the mercury. If water be placed on the mercury, the arc is quickly extinguished. With this break the coil is most powerfully excited, but the mercury is soon whipped into a thick paste or emulsion, and besides, there frequently occurs an extremely powerful spark apt to puncture the tube.

(6) The usual vibrating make-and-break. This device may be called a standard one from its almost universal application, and for ordinary work leaves little to be desired. It has several bad points, however. The tension of the spring is not readily adjustable, and, in common with all vibrating springs, being rigidly fixed at one end, it takes up harmonics and produces irregular sparks.

(7) This type consists of an iron lever actuated by the magnetism of the core. Since in the writer's experience this form has given the most uniform and powerful results of all the various mechanical and magentic devices tested, a detailed description may be of interest.

This device was made by Carpentier, of Paris, and deserves to be more generally used. The dimensions of the lever are 3 x 5-16 x 1/8 inches. It is pivoted through the edges, so as to present a flat surface to the core. Near one end is a contact screw, tipped with platinum; near the other, a hole 1/4-inch diameter is drilled, and a flat spring projects over it. The tension of the spring is readily adjustable, and the speed of the vibrator can be varied through wide limits. It has been found best to braze platinum tips cut from No. 6 wire to screw points. The large contact surface insures good action and long life, while new points may be inserted with the greatest ease. This device is now in constant use on a coil capable of yielding sparks 14 inches in length. By its use either the pear-shaped or focus tubes can be so powerfully excited as to easily penetrate all portions of the body.

For exciting old tubes in which the vacuum has become abnormally high, a mechanical interrupter is employed.

The use of water in the mercury break suggested running a mechanical interrupter under water. For several months the writer has been experimenting with this device. It has been found, in brief, to be the most efficient mechanical interrupter so far tried. It may be constructed in a variety of styles. The particular type which gave the best results was that described above (2). The contact wheel and brush were immersed in water, and the arcing was almost wholly prevented. The wear on the brush and contacts was extremely rapid, due to oxidation by the electrolytic action of the spark at the interruption of the current. Since the brush is the part more readily renewed, it was operated with a positive polarity. Various metals were tested for contacts and brushes, but copper and silver gave best results. The same device may be run in oil, but oxidation will still occur. Though it proved to be the most successful of the mechanical interrupters, yet it was abandoned on account of the destructive electrolytic action.

From this type, however, was developed a mechanical interrupter which proved quite satisfactory. A vertically mounted shaft carries a disk, shown in Figs. 1 and 2. Bearing on this is a carbon brush, soft, and containing a good deal of graphite. The essential features of the disk are the removable insulating and contact pieces. The main insulation is by two quadrants of rubber (E, E). The spark occurs at the juncture of each pair of removable strips (C D). One of each pair is of glass, the other of either brass or copper.

In operation the arc is found to be short and but little destructive, the wear falling principally on the carbon brush. When the metal contacts are too worn for use, they may be readily replaced by removing two screws in each.

Armour Institute of Technology, Chicago, Ill.

Letters to the Editor.

POWER TRANSMISSION AT FAIR HAVEN, VT.

In an article in your issue of October 21, on "The Present State of Electrical Transmission," by Dr. Louis Duncan, a list is given of the plants now in operation.

I have no feeling in the matter, but think it due to our friends, the Westinghouse people, that it should be recognized that our plant is one of the successful power transmission plants of the country. It has been done in a quiet way, no stocks, bonds or scrip being issued, simply everything built for cash and as an investment. It includes a water power developed (our least noted volume 500 horse-power) of 120 feet fall, two steel tubes 500 feet each to a 100 horse-power and 150 horse-power wheels, with a small one 25 horse-power for separately driving exciters, a 150 kilowatt two-phase and 75 kilowatt single-phase, supplying power to motors 2, 4, 7 miles each, lighting two towns 4 and 11 miles distant, by arcs and incandescents, driving a 75 kilowatt two-phase motor synchronous at quarries 7 miles off with the motor so built and equipped with all instruments that it can be driven as a generator from the steam plant kept in reserve there and so protect the lighting of the two towns in case of accident at the Falls.

As I stated above, it has been done quietly, avoiding newspaper notoriety, but taking up and solving all the problems of long distance transmission, power (we started the first two-phase motor in New England for commercial purposes) light, heat and cooking.

We have no desire to have our names in the papers, only to be included in the lists when given of power plants.

Fair Haven, Vt.

A. TUTTLE, Treas.,
Carvers Falls Power Company.

THE

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CONTENTS.

THE ELECTION AND AFTER.

With an emphasis that no man can mistake, the American people have expressed their opinion in regard to the dishonest delusion that when times are hard the way out is to issue money which as bullion is not worth half the value stamped on it, so that debts may be paid in a debased currency. It would have seemed that this world of ours had been through that experience too often with failure and disaster to try it again, and had found out too often that no government stamp can ever give fictitious value to anything, but humanity is liable to crazes of this kind, and it takes a large amount of education and a high sense of public morality to fight them down. By nearly 100 votes majority in the electoral college and over 1,000,000 majority in the popular vote the brains, wealth, conscience and public spirit of the United States have defeated the proposition that this country should be a repudiator, and the verdict has at once carried with it the promise and the certainty of better days. Our financial and banking system is still in need of many reforms, but they will now be sought on the lines of common decency and normal fair dealing.

While the vote for sound money has been so overwhelming, we believe that it would have been even larger but for the profound feeling of distrust and defiance as to the organizations now grouped in popular parlance under the general head of "combines and trusts." The Bryan vote was not altogether a vote for silver, and it would have been much smaller if Mr. Bryan had only been the spokesman of the silver combine, but Mr. Bryan was able to make an appeal to the discontented and unfortunate that was all the stronger because it embraced many half truths and probably some whole truths as to the favoring of certain groups of producers or manufacturers at the public cost. There will be and there must be legislation in further check upon those who, by massing influence and wealth, propose to drive others out of business. Unrestrained competition is bad, but, if we understand the public temper, it is felt that unrestricted combination is worse.

In this respect, as in many others, the Republican party is on trial, its great victory having been achieved solely with the help of patriotic Democratic voters, and it remains to be seen how fairly it will hold the scales and adjust the burdens of taxation. Capital and the fruits of labor can best be protected by equitable laws that deprive even the visionary or the discontented among us of any grounds for assault, and enterprise will be the quicker to manifest itself when there is no fear that selfish monopolies can interpose to deprive any one of his reward or his occupation.

In the electrical field the new era opens auspiciously, and with the dawn of last Wednesday morning better times began for every branch of electrical industry. Our own pages bear witness to the renewed activity of all kinds of electrical enterprises, and there is every reason to believe that only a beginning has been made. It is for this reason that at this moment we hasten to deprecate and condemn the measures attributed to the General Electric Co. We hear of efforts made by it within the last few days to swing street railway companies into line by offering to let bygone purchases of alleged "infringing" apparatus be forgiven for one dollar, but tieing up the companies, as an offset, in regard to further purchases, except on payment of $50 for each motor equipment bought outside, and $1 per horse-power for generators. The evidence as to this move is tolerably specific, and, in fact, would be hard to conceal. If this be the continuing policy of the company, we do not hesitate to brand it as detestable.

CONVEYING THE ELECTION NEWS.

ACCOMPANYING the intense excitement over the recent election went an eager desire for early and full news as to the result. An article appearing elsewhere in our pages gives an excellent idea of the manner in which, with the aid of the latest and best electrical apparatus that could be secured, the newspapers proclaimed the news either on their novel bulletin boards to thousands or by means of flashing mid-air beams to waiting distant millions of people. Large sums of money and extraordinary ingenuity were expended, and the results were commensurate in the brilliant success achieved.

Last week we noted a good deal of the special work in this line done by the telegraph and telephone companies. Speaking from personal experience, we can pronounce the telephone experiment a great hit. The news given out telephonically was remarkably full and accurate, not presenting mere little bits of local results, but including the whole country in its scope. We sat, like many thousands of other telephone subscribers, with the telephone at our ear from 7:30 p. m. to 10:30 p. m., and in that period received and posted up for assembled friends some 250 excellent bulletins, winding up with the evidence of McKinley's election. The long distance telephone services, in all the cities, are to be heartily congratulated on their good and thorough work. Sitting at home quietly, one missed, no doubt, the hurly-burly of the big, shouting outdoor mobs of excited enthusiasts, but one got all the news and got it quickly.

The telegraph companies, as we stated last week, have had to make very heavy preparations, and the work of which we spoke was well done. The Western Union Company, from the fact of its universal ramifications, bore the brunt of the more general service from all the States, and the number of its bulletins from the various distributing points must have run into millions. For example, between 6 p. m. Tuesday and 4 a. m. Wednesday it sent out 523 bulletins over more than 500 wires, making over 260,000 bulletins from this city alone. In this city and Brooklyn it had over 400 special wire connections, as against 161 four years ago. In Chicago the number of orders for wire service reached over 250; in fact, the work done was everywhere limited only by the number of operators obtainable.

The Postal Telegraph Company reports also having done an enormous business, especially in the cities to which it has always confined its efforts more particularly. In Philadelphia it had 150 special election customers, and states that there as in Chicago "election return parties" with its service became a feature of the occasion. When to all this work is added that of the press associations, it will be seen that the peak of the load ran up to a height heretofore undreamed of, while the service was cheaper and better than ever before.

Electrical means of communication are desirable at any time, but they are best appreciated in the hours of great popular emotion and excitement, when the fate of a nation hangs on the flash of the searchlight, the click of the sounder and the vibration of the telephone diaphragm.

SILVER AND COPPER.

THERE is now a chance that silver as a metal will reach its proper level and sell for what it is actually worth. It has too long been regarded with an absurdly superstitious reverence and much too seriously treated as a "precious" metal. The simple plain facts are that at present rates of production and without the bolstering up of government credit silver is likely to go lower in price. Even then the producer has a handsome margin of profit when his cost is only 17 or 20 cents an ounce. Silver has few qualities of special merit, being heavy for its value, easy to imitate, readily attacked by acids, and tarnishing at the contact of a mere rubber band; while on a lower plane of values, iron and copper are long likely to remain preferable. It remains to be seen what effect on the price of copper the presumably smaller extraction of silver may have. As shown in our pages recently, in much of the electrolytic copper working in the West, the by-product of silver has been a handsome profit in itself, and it remains to be seen also whether the price of copper in view of the larger demand for that metal and the lesser demand for silver may not affect Montana to the benefit of the Lake Superior copper regions. It is possible, on the other hand, that cheaper silver may be more largely used in the domestic arts and decorations. If so, the value may not go off very seriously and there may still be sufficient incentive to the active working of the Western copper-silver deposits. The situation is evidently interesting, and in the meantime we note hardening prices for copper, with a decline in silver.

EDUCATIONAL.

DR. SHELDON ON ELECTRICAL MEASUREMENTS OF PRECISION.

DR. Samuel Sheldon delivered a lecture on Friday evening, November 6, before the Electrical Department of the Brooklyn Institute on "Recent Methods in Electrical Measurements of Precision." The lecture was given in the physics lecture room of the Polytechnic Institute. The following is a synopsis of what was said by the lecturer:

There has been an evolutionary advance and improvement in methods of electrical measurement which is entirely commensurate with the recent advances in general science and its commercial applications. The quantities which we are generally called upon to determine are those which enter into Ohm's law, viz., current, resistance and difference of potential. Accompanying these, determinations of length, mass, time, and temperature are often required. If the accuracy of the determination is such that an error of 1 in 1,000 is not permissible, the determination may be called a measurement of precision. Commercial measurements are seldom objected to when the errors amount to 1 or even 5 per cent. of the magnitude of the quantity measured. Commercial measurements of insulation resistance have been accepted when the inaccuracy was probably 75 per cent. Such measurements by means of a Weston voltmeter are often accepted.

In nearly all cases so-called electrical measurements are really comparisons with some standard. Measurements of resistance are very seldom made. Instead, a comparison with a wire standard is made. It will thus be seen that to determine all or any of the three above mentioned magnitudes necessitates the possession of standards of at least two of the magnitudes. A few years ago the accepted standards were of resistance and of current. To-day they are of resistance and electromotive force.

The resistance standards of a few years ago were faulty in many respects. Their absolute magnitudes were not in accordance with the system of units they were supposed to fit. Their material was German silver, platinoid or platinum silver, materials which possess fairly large and surely uncertain temperature coefficients. Added to this, they were generally constructed in such a form as to ensure an uncertainty as to the actual temperature of the wire. When made in the form of resistance boxes, the plugs, blocks, and posts, possessing an appreciable resistance, were sometimes included in the nominal circuit and sometimes not. To-day we have three materials which have practically negligible temperature coefficients, viz., manganin, constantin and a material known under the trade name of Ia Ia. In addition to this the form of modern resistance standards has been improved so that the temperature of the wire can be very accurately determined.

The old standards of current were the tangent galvanometer and the silver voltameter. A precise measurement with the former instrument required first of all a very accurate measurement of the dimensions of the instrument and a faith that they would remain constant during the whole determination. In the second place it was necessary to determine, by a tedious method, the value of the horizontal component of the earth's magnetism. The constancy of this value was never to be relied upon in the olden times, and its inconstancy, due to vagabond earth currents, at the present time has driven the instrument out of use as an instrument of precision. The voltameter becomes a current meter only after dividing its indications by the time that the current, which is to be measured, has flowed through it. A constancy of current during that time is pre-supposed. The voltameter is furthermore limited in range. Instead of either of these standards, a standard of electromotive force is now generally employed. It is the Clark cell, constructed according to the specifications laid down by the Chicago Electrical Congress.

In the measurement of resistances larger than 100,000 ohms, there is no practicable zero method. Over the wide range between this magnitude and 10 ohms, the Wheatstone bridge with adjustable resistances is to be recommended. Over the limited range of 10 to 300 ohms, the Kohlrausch pattern of the Kirchhoff slide wire bridge gives good results, if the wire is uniform and has been calibrated. Between 10 and 0.5 ohms the Carey-Foster method yields results that are beyond criticism. Smaller resistances than these can be measured by the Kelvin double bridge, the method of Matthiessen and Hockin, or the method of the differential galvanometer. The two first methods require a standard wire, and the last an instrument that has not received the attention that it deserves. The fact that it is now possible to obtain very small standard resistances of great accuracy furnishes a foundation for a method of determining these small resistances with great accuracy.

ELECTRIC LIGHTING.

STUDIES IN THE SPECTRUM OF REFLECTION.

BY DR. W. H. BIRCHMORE.

IN the issue of The Electrical Engineer for September 30, 1896, I gave in round numbers the total relative reflection areas of illumination of certain paper surfaces. I had intended to discuss quite another part of the subject in the present chapter, but my attention has been called to the fact that a part of what I have already written is obscure from lack of explicit statement, and as it is useless to build on an insecure foundation, I must to an extent retrace my steps. I explained, I think sufficiently, the nature of the factor called the "index of reflection," but I appear not to have made sufficiently clear its bearings on the matter in hand.

The figures of Meyer cover the lines B, D, E and G, and the immediate regions on either side, and it was not intended to say, except tentatively, that the waves between them followed the law of proportions, although until they have all been measured this forms an hypothesis both reasonable and workable. It should be remembered that it is an hypothesis; that this fact is admitted and that no claim has been put forward that it is anything more, and further his equations come very near to the measured quantities where other lines have been measured. To increase the number of lines and constants I have measured two sets in sunlight and the filament lamp, the regions of C and F. At C my quantity values give a curve slightly larger in area than Meyer's when sunlight is studied, and slightly smaller for the filament lamp. At F my quantities are greater than Meyer's should be for the filament lamp. Elsewhere the agreement is so close as to lead to the influence of instrumental differences or of differences in illumination.

There is one point which must be urgently considered. Was the amount of force made effective in the filament lamps the same in his experiments as in mine? Every one who has come in contact with the subject knows how difficult and how intricate this problem is, and it does not become any less tangled by further study. The great influence exercised on temperature and, therefore, on spectrum by small differences of current is as remarkable a phenomenon as any in the list. From this and certain experiments to be discussed later, I am inclined to think that the temperature of the carbon filaments in my lamps may have been, probably was, somewhat higher than those used by Meyer; which would, in theory, cause an increased relative blue emission in my lamps, which would agree well with that measured.

In this contribution I have made use of the Meyerian equivalents, interpolating my own to make the list of constants larger, This gives six series of points, instead of four, for each source of illumination, and is fully expressed as follows, the quantities given being the product of the index of reflection by the Meyerian equivalent.

SUNLIGHT.

Line in Spectrum.	B.	C.	D.	E.	F.	G.
Sample A	684	545	189.6	29.6	19	7.6
Sample B	259.2	165	63.7	36.5	22	7.6
Sample C	1,512	1,105	247.8	91.2	50	7.6
Sample D	1,540.8	1,215	481.4	67.7	38	7.6

ELECTRIC (FILAMENT) LIGHT.

Line in Spectrum.	B.	C.	D.	E.	F.	G.
Sample A	76	110	176.2	143.5	110	81
Sample B	28.8	52.5	94.7	176.6	132.5	81
Sample C	168	235	368.2	441.6	310	81
Sample D	171.2	340	715.3	327.5	205	81

It has been objected to the use I made of these figures that, as I placed them, they might "mislead those unfamiliar with the spectrum as to the relative quantities of light of different sorts reflected." If this be a possibility of the future, it is equally so of the past and must be corrected.

In my last contribution I suggest the plotting of the curves by the method of Angstrom and Thalen; I now strongly insist on the importance of this proceeding. This scale of Angstrom is an arbitrary one, as is that of Kirchoff and Hoffman, but it is independent of the instrument. It consists in giving definite linear expression to certain definite differences in wave length. My own method has been as follows:

Starting with the assumption that the lengths of the waves expressed by the nomenclature in common use are as follows: A = 0.76009 microns. B = 0.68668 microns. C = 0.65618 microns. D = 0.58920 microns. E = 0.52689 microns. F = 0.48606 microns. G = 0.43072 microns.

A micron is a one-thousandth part of a millimeter, and is the micro-millimeter, or small unit which is commonly designated by the Greek letter μ.

I used a machine divided scale of 1/16th inch for my scale as follows: The distance between 0.4307 and 0.4308 was assumed as infinitesimal, that 0.4300 and 0.4310 to be represented by 1/16th inch; consequently that from 0.4300 to 0.4400 would be represented by 10/16th of an inch. Such a scale is rapidly constructed, and at this scale the ability to plot runs the ability to see very close indeed, so that the errors are not vital, probably are imperceptible.

On such a scale the given lines are erected and the values given for the index of reflection into Meyer's equivalent laid off, using the same scale to represent a unit of 1/10th. Thus under Sunlight B, sample D, equivalent product 1,540.8, would be plotted as 154/16th of an inch, or 9 inches, and 10/16th, and the process continued until all the curves became graphics. Such curves then describe areas, which can readily be reduced and summed. Such a proceeding gives a much better notion of the differences in the location of the potential of illumination than any amount of description, or multiplicity of figures. Thus reduced and summed the relative illumination may be expressed as follows:

NUMBER OF AREA OF ILLUMINATION OF CERTAIN WALLPAPER SAMPLES.

SUNLIGHT.

Line of Spectrum and area.	Sample. A.	B.	C.	D.
B to C region....	187.5	64.4	399	420.5
C to D region....	245.8	76.7	453.5	568
D to E region....	68.4	31.3	99.6	171.5
E to F region....	10	12	28.9	21.6
F to G region....	7.4	8.2	16	12.6
Illumination	519.1	192.6	997	1,194.2

ELECTRIC (FILAMENT) LIGHT.

Line of Spectrum and area.	Sample. A.	B.	C.	D.
B to C region....	29.9	12.4	61.2	77.9
C to D region....	95.8	49.3	202	353
D to E region....	99.8	84.6	252	325
E to F region....	51.8	63.3	153.5	108.7
F to G region....	52.9	59.2	108.3	79.3
Illumination	330.2	268.8	777	943.9

If these figures be multiplied by 1,000 (10^3) they will express as near as may be by any at present available method the regional and actual reflections for illumination purposes.

It may be urged, and with some justice, that this method assumes a wider acquaintance with spectrology than actually exists; to avoid this criticism, I have reduced this to the colored regions by the following method:

It is, of course, widely known that no two human beings will agree as to the precise part of the spectrum when one color (so called) passes into another, but by a sort of common consent certain wave lengths have been agreed to as expressing these divisional lines. These may be considered either as classic, orthodox, or provisional, as the reader be inclined, if well acquainted with the instrumentation the wave lengths and not the colors are important; if used to the more obvious but less precise method the accuracy of the division is sufficient to serve the need.

The wave lengths assumed are as follows: Between red and orange, 6,460; orange and yellow, 5,945; yellow and green, 4,895; green and blue, 4,600; blue and violet, 4,307.

If the suggestion of plotting the curves has been carried out these divisional lines can be readily drawn in and thus the colored regions located, with sufficient accuracy for all practical purpose.

The ordinates can be measured from the curves and used as a means of obtaining the areas, or the ordinates can be calculated from the equations of the curves, or best, the ordinates can be measured by photometric measures for the given wave lengths.

This last method is undoubtedly the proper one, but it implies instruments, skill, patience and an abundance of time; to the average reader direct measure is recommended. This method wil come near enough for all ordinary uses, and will, if comparison only is intended, be equally satisfactory, may be more so, with the laborious one which the investigator of such phenomena must perforce use.

Table giving expressions for the Illumination Values of the Samples in terms of the "colors of the rays" is as follows:

SUNLIGHT.

Colors.	Sample.	A.	B.	C.	D.
Red	6,869—6,460	231.5	91.8	491.5	527.5
Orange	6,460—5,945	169	55.3	306	394
Yellow	5,945—5,352	63.2	31.4	121.5	187.5
Green	5,352—4,895	17.5	14.9	56.2	51.3
Blue	4,895—4,600	5.3	5.3	13.3	8.9
Violet	4,600—4,307	2.6	2.6	5.6	4.1
Illumination		489.1	201.3	994.1	1,173.3

ELECTRIC LIGHT.

Colors.	Sample.	A.	B.	C.	D.
Red	6,869—6,460	39.1	17.2	82	148
Orange	6,460—5,945	84	59.7	165	275.5
Yellow	5,945—5,352	71.1	100	239	316.5
Green	5,352—4,895	61.1	73.3	175	142
Blue	4,895—4,600	28.4	35.4	75.4	52
Violet	4,600—4,307	25.2	27.2	37.5	32.2
Illumination		308.9	312.8	773.9	966.2

These quantities multiplied by the same factor, 10^6, will give the ratios within a reasonable limit as before.

It will be at once noticed that these figures do not agree with those of the previous table in summation. It would be very remarkable indeed if they did; such an agreement would probably be only an accident, and would throw, in my own opinion, doubt upon the competency of the whole work. As they stand, they express the result of a certain amount of labor, the discussion of certain observations and this alone.

Undoubtedly as data accumulate sources of error will be discovered, errors in observation will be checked and eliminated, and in process of time the two summations will agree. But before any such agreement could be accepted as satisfactory, to my own mind, not days, but months of work must be added to the total already expended.

In discussing the results it will make small difference which series of figures are used, as suggestion, not instruction, is the purpose of my work. It is not my wish to set up landmarks, but to incite others to explore, and if I have managed to fill in a few "lakes and mountains" I have succeeded in my ambition; future journeys can connect the lakes, so be they join, and map the mountains and valleys between them.

AUTOMATIC SWITCH FOR CHARGING ACCUMULATORS FROM AN ARC CIRCUIT.

BY EDGAR KIDWELL.

THE writer has at times needed an automatic switch for charging storage cells from an arc circuit, but failed to find in the market anything answering his particular needs. He therefore worked out the instrument here described. It has been very satisfactory to him, and may perhaps be of use to others.

The problem was to so design the instrument that in case one wished to charge during the hours when the arc service is in operation, he would need only to throw his main switch at any time during the day, leaving to the automatic switch

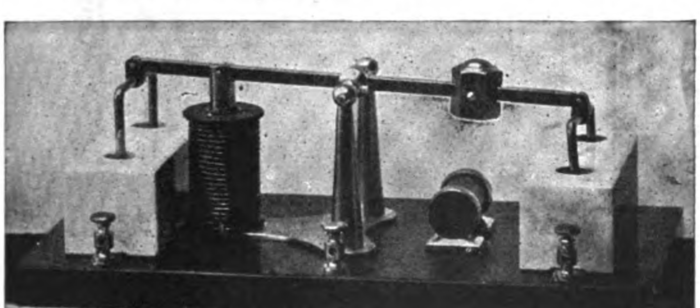


FIG. 1.—KIDWELL AUTOMATIC CIRCUIT BREAKER FOR CHARGING STORAGE BATTERIES FROM ARC CIRCUITS.

the task of turning the current into the cells at the proper time, keeping the line circuit always intact, yet promptly breaking the cell circuit whenever the dynamo stops, or in case of any breakage of the line. The writer thinks it unwise to subject a battery worth over $1,000 to the danger of discharging through the line, in case of accident, or neglect to keep station switches open.

The instrument is shown in Fig. 1, and its connections in Fig. 2. G, H, and K are binding posts. To opposite ends of the lever shown in Fig. 1 are attached U-shaped copper connections, which drop into mercury cups, aa, and bb. It is clear that if path A is closed, and B is open, the line is intact, and cells are cut out. If path B is closed, and A is open, charging

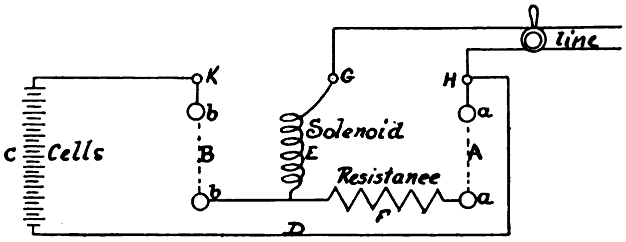


FIG. 2.

of cells will proceed. The counterweight on the lever is adjusted so that A remains closed until current in line (maximum strength, 6.8 amperes) rises to 3 amperes, then solenoid E acts on the plunger, tilts the lever, opens A, closes B, and charging proceeds until current drops to 3 amperes, whereupon the cells are cut out.

It is, of course, inadmissible to open the main circuit for an instant, hence it is clear that the height of the mercury in the cups must be such that B is closed before A is opened, and vice-versa. Hence it follows that during the act of switching

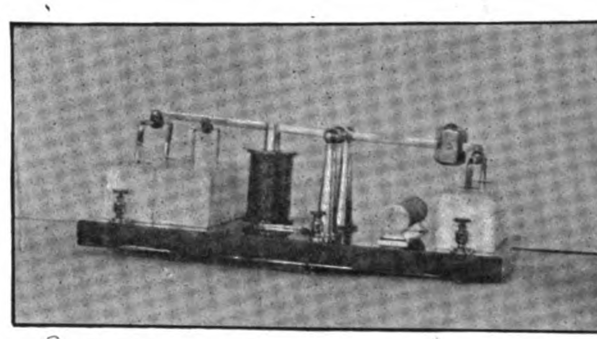


FIG. 3.—THE KIDWELL AUTOMATIC SWITCH.

both A and B must be closed during an interval of time depending on the rapidity with which the current in the line rises or drops as the dynamo is started or stopped. During this interval the line current is traveling via G F A H, and the cells are short-circuited through path K C D H A B. Unless some resistance be placed in the latter path, the cells will be quickly destroyed by the sudden excessive discharges, hence at F is placed a non-inductive graphite resistance such that during the time of short circuit the cells cannot discharge a current greater than 25 per cent. of their maximum safe

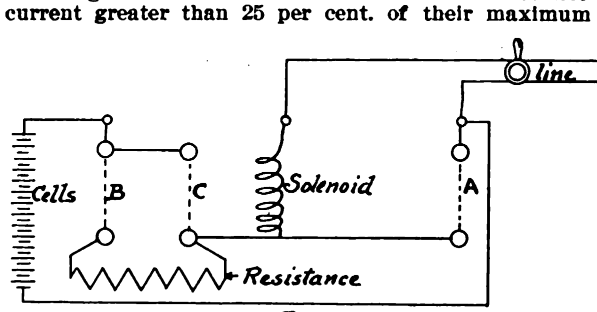


FIG. 4.

capacity. It is clear that with solenoid set to act at 3 amperes this resistance is switched out of the line before the lamps strike their arcs.

By arranging apparatus as in Figs. 3 and 4, an ordinary form of resistance frame, even if it has considerable self-induction, may be used in place of the graphite resistance. Three pairs of cups, at A, B and C, are used, the only precaution to be observed being that the height of the mercury in the cups must be such that when the lever tilts, B is closed before A is opened, then A is opened, then finally C is closed. The path of the current at each stage can easily be traced out.

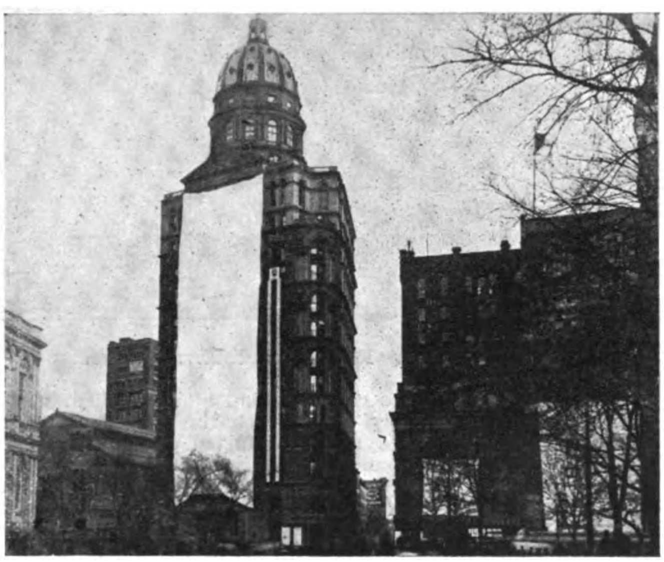
The writer takes pleasure in acknowledging his obligations to the Automatic Circuit Breaker Company, Newaygo, Mich., who built the instrument from his sketches, and to whom all credit for the mechanical details is due.

ELECTRICITY IN THE RECENT POLITICAL CAMPAIGN.

BY THEODORE WATERS.

THE political campaign of 1896 will be memorable in the time to come for reasons other than those embraced by its party and financial interests. In addition to the remarkable victory for sound money another triumph has been scored. In more ways than one the recent contest has shown how absolutely dependent we are upon electricity for the successful promulgation of all great modern social improvements. Everywhere during the campaign the current was used in some manner, direct or indirect, to enhance the enthusiasm or to further the business interests of the political managers. The telegraph and telephone in the day time; the electric lamp at night, were kept going constantly. Some stupendous figures were deduced in the first place and some wonderful engineering feats were accomplished in the second. Of the first we shall speak elsewhere. Of the second there is an interesting tale to be told.

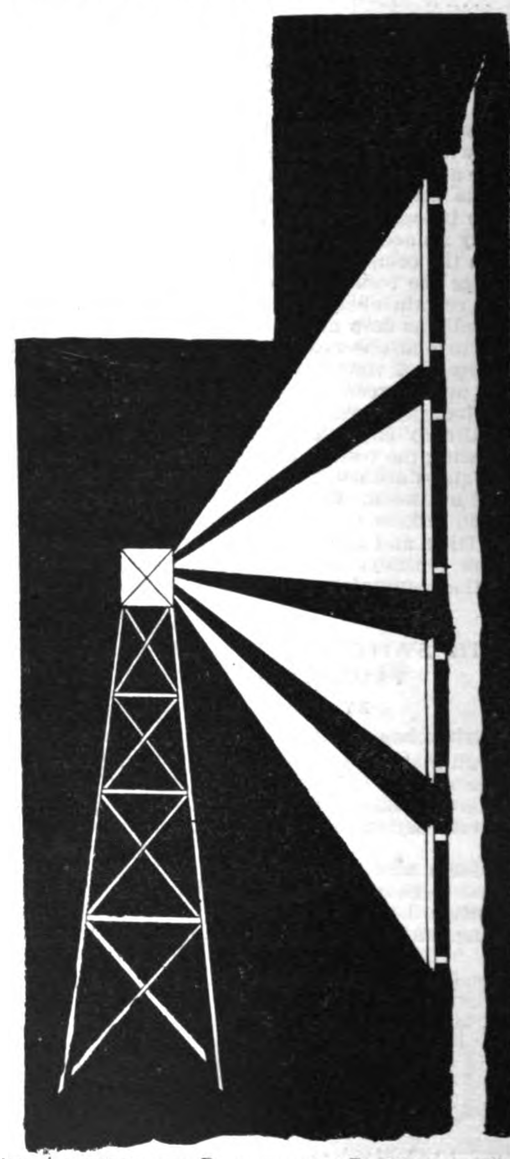
In New York City, where great financial and industrial interest were at stake, the excitement was intense, and of course the large daily newspapers of the metropolis vied with each other in an effort to present the returns of the election to their constituents in as striking a manner as possible. The New York "World" made arrangements to flash the news of the election by means of search lights placed high up in the great dome of the "World" Building. The dome was also lighted as usual with incandescent lamps, and colored lines of light were used to signal the result to the people of the city far and wide. For those persons who were more desirous of



THE WORLD BUILDING READY FOR THE ELECTION RETURNS.
Copyright, Nov. 7, 1896.
FROM A PHOTOGRAPH BY J. B. COLT & CO.

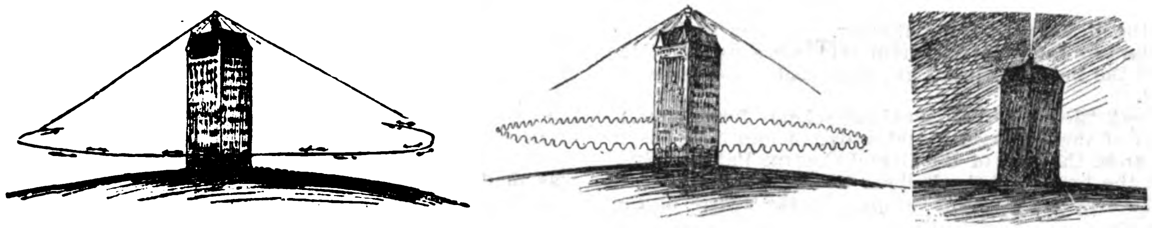
learning the details of the election, stereopticon exhibits were arranged. The whole front of the "World" building was covered with an immense canvas screen 180 feet high and 60 feet wide. Upon this six immense disks of light were projected. The projectors were operated from a tower 40 feet high, stationed in City Hall Park, 145 feet from the building. The electrical features of this tower were very interesting. The projecting lanterns were of the Criterion type manufactured by J. B. Colt & Co., of 115-117 Nassau street, New York, and were operated of course by an electric current. The tower was in a measure a central station, situated high in the air and getting its supply of current from two large mains which were connected to the private lighting plant in the "World" building, and which were strung through the air from an upper story window of the building. The tower was equipped with a switchboard and controlling rheostats. Each lantern had its individual rheostat and was in no way dependent upon the others. The installation had almost the appearance of a permanent plant and might have been maintained as it was for any length of time. The news as it was received in the "World" building was relayed to an extra telegraph receiver in charge of an operator stationed in the tower. Previous to the time when the returns were received, the lanterns were used to project various edifying scenes upon the canvas, much to the amusement and delight of the crowd. The two upper circles of light upon the canvas were 60 feet in diameter each. The four lower circles of light were 30 feet in diameter each. About 40 amperes of current were used upon each upper disk and about 30 amperes were used upon each of the lower disks. 5-inch condensers were used, with ⅝-inch soft-cored carbons. The calculated illumination of each disk was 10,000 candle-power. An ordinary voltage of 110 was employed. The World also had a 25x50-foot screen on the front of the Union Dime Savings Bank, at Thirty-second street and Broadway. On this screen there were two disks of light 25 feet in diameter each. "Criterion" lanterns were used here also, under about the same conditions as those used further downtown.

It is worthy of notice that this is by far the largest projection ever made, either here or in Europe, and the screen is also by far the largest ever constructed for such work. All of the work was under the personal direction of Mr. R. C. Daniels. We illustrate herewith the methods used, and are indebted to J. B. Colt & Company for great kindness in furnishing the details and material of illustrations.



STAND FOR LANTERNS AND PROJECTION OF RETURNS ON WORLD BULLETIN BOARDS, NEW YORK PRINTING HOUSE SQUARE.

The New York "Times" and the New York "Journal" also operated a stereopticon in front of their respective buildings. It may be remarked however, that these plants differed from the plant in front of the "World" building for the reason that a three-wire system was used in place of a two-wire system. The latter was necessary in the case of the "World" plant because the private installation in the "World" building is of the two-wire variety. In the tower erected by the New York "Times," in Park Row, five Criterion stereopticons were used, throwing five disks of light on a 42-foot screen. The tower was only 18 feet high. This necessitated a very acute angle of light being thrown upon the screen. The "Times" also had a display at Twenty-third street and Broadway. Here two disks 20 feet in diameter and two lanterns were used. The New York "Journal" used four lanterns in a tower



CIRCULAR SWEEP—MCKINLEY. WAVY BEAM—BRYAN. VERTICAL BEAM—IN DOUBT.

METHOD EMPLOYED IN CHICAGO OF INDICATING ELECTION RESULT FROM MASONIC TEMPLE BY SEARCHLIGHT.

erected in front of its office in Park Row. The ordinary 110-volt three-wire system was used. About 20 amperes were used on each disk. A remarkable feature of the "World" tower stationed at Thirty-second street was its having three

World. *Sun.* *Journal.* *Tribune.* *Times.*

METHOD OF DISPLAYING ELECTION RETURNS ON CITY HALL SQUARE AND PRINTING HOUSE SQUARE, NEW YORK.

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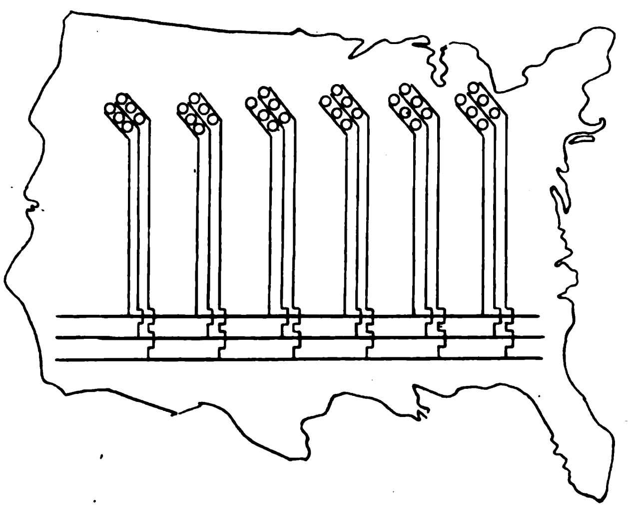
(APPARATUS OF J. B. COLT & CO. FROM A PHOTOGRAPH TAKEN BY J. B. COLT & CO.)

stories. The two lower stories were used for the operation of Criterion lanterns. The top story was used to operate the "Biograph," which, during the early part of the evening, projected its moving pictures upon the disks which were afterwards used for election returns.

The New York "World" also made arrangements to flash signals of electric light from various high points in New York and Jersey City. A searchlight was operated on the high tower of the Manhattan Life Insurance building, from the tower of the Siegel-Cooper Company's building, from the roof of the Rushmore Dynamo Works, in Jersey City, and from the high eminence at Fort George, on the northern end of the island. The light from the Siegel-Cooper Company's tower was distinguished at Poughkeepsie, more than seventy-five

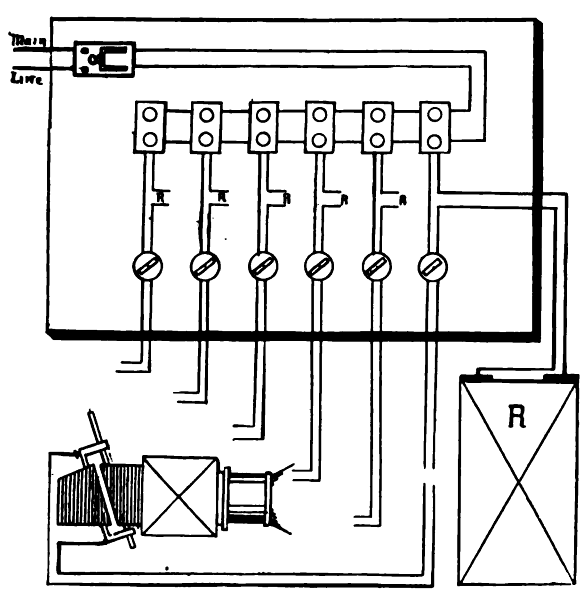
miles away, the night being fine and clear. Fourteen Rushmore naval projectors of the most powerful type were used in Jersey City, and the flash of their light was visible for miles in all directions.

The New York "Journal" had a unique scheme for transmitting the news of the victory far and wide. A captive balloon was sent up from the roof of the Grand Central Palace. Suspended from the basket of the balloon was an immense star, composed of white incandescent lamps. In the centre of the



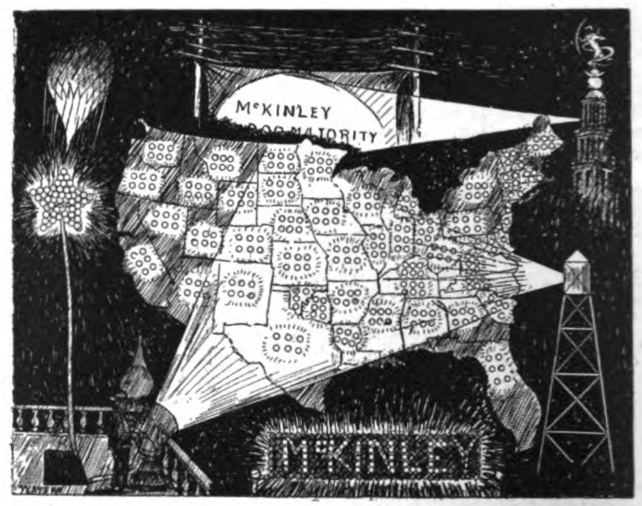
Circuits for Lighting Indicator Red and Green Lamps on the Map.

white star were a number of green and red lights intermixed. At the proper moment the red or green lights were to be flashed, each color corresponding to the successful political organization. As a matter of fact, the green, denoting the Republican victory, was used alone. The lamps were operated from a switchboard in the building and the current was carried from the local plant by a heavy cable, which also served the useful purpose of securing the balloon to the roof of the building. The illumination was very effective. Another scheme which the "Journal" put in operation was a map of



Circuit and Arrangement for the Colt Lanterns on the World Stand.

the United States, which was stretched over the lower portion of the "Journal" building, and on which the name of each State was to be illuminated in either red or green lamps, accordingly as each State went Republican or Democratic. The erection of this map was something of an engineering feat. The scheme was not conceived of until two days before election. It was painted, erected and the electrical installation made in time for a successful display. The three-wire system was used. There were three red and three green lights for each State. The neutral wire, of course, occupied a position between the two rows, and before the returns were received it was permanently connected to the neutral main, which extended across the building just back of the map. As the result of each State election was received, the leg, or wire corresponding to the red or green row of lamps was quickly attached to its corresponding main, and thus the installation was made temporarily with as little trouble as possible. It may be remarked that no accidents of any kind were en-



Map, Balloon, Star and other Effects, with Electric Light, Election Night.

countered. The whole affair was torn down within a few hours after it was used.

The New York "Herald" made use of the beautiful Madison Square Garden tower to flash the result of the election around the city by means of powerful naval projectors. As a matter of fact, the clear, cold atmosphere above New York City was being constantly illuminated in all directions by the dazzling shafts of light which were projected from many high towers. The cinematograph, the biograph and the vitascope were used in several parts of the city by the various newspa-

Search Light on Dome of Manhattan Building.

pers to amuse the crowd during the evening before the election returns were received. All the theatres were illuminated and many of them furnished the returns by means of projecting lanterns with screens stationed temporarily upon the stage between the acts. Many of the high buildings were illuminated, of course, and, in fact, everywhere it was evident that wherever it was obtainable the electric current was thought to be the proper thing for celebrating the election.

The large screen of the New York "Tribune," adjoining that

of the "Journal," on Printing House Square, was operated by means of the hand-feed Bijou lamp, with single Institute stereopticon, furnished by Mr. Charles Beseler, of Centre street, New York City. Great fun was created by the rapid exchange of remarks on the "Tribune" and "Journal" bulletin boards, the former being Republican and the latter Democratic. The same Beseler apparatus was furnished to the Detroit (Mich.) "Journal" for its election return work.

In Chicago, the same free resort was made to electricity. The Chicago "Record," for example, took possession of the top of the tall Masonic Temple, and by means of a General Electric searchlight, gave out the news of the result far across the tumultuous city and the waiting prairies. The plan is here illustrated. The election of Mr. McKinley was illustrated by means of a steady horizontal sweep of the beam of light from left to right and right to left. Had Mr. Bryan

SIGNAL OF VICTORY WITH FOURTEEN SEARCH LIGHTS, FROM RUSHMORE FACTORY, JERSEY CITY.

won the light would have had the staggers, and had the result been in doubt an appealing finger would have been raised to the heavens for a righteous decision. The Masonic Temple dome is 324 feet above the level of the street, and current was led up to the light by special cables from the plant in the basement of the building.

Various details were given in The Electrical Engineer last week as to the work done specially by the telegraph and telephone in handling the election returns. Further reference is made to that part of the subject in the editorial comment this week.

MYSTEROUS BREAKDOWNS OF INSULATION.

BY PROF. ELIHU THOMSON.

APROPOS of the editorial in The Electrical Engineer of October 21 on "Mysterious Breakdowns in Insulation," it will be recalled that formerly the practice in insulating electrical apparatus was to make the insulation sufficient to stand the working potential, whereas nowadays the practice is becoming more general to test the insulation of apparatus by submitting it to strains of very much greater amount than that which is likely to exist in practice with the apparatus, giving a condition similar to that secured by the "factor of safety" which is always used in mechanical construction. At the same time a large measure of attention is now being given to the examination of insulating materials, of which we have none too many with the properties which are desirable.

The more general use of mica as a constituent of insulation has, of course, had its good effects where the peculiar characteristics of mica as an insulator were needed, and it is now the practice in the best equipped establishments to test the insulating qualities of all materials before making use of them. I think, therefore, that the great improvements which have been, up to this time, shown in the methods of electrical construction, particularly in view of the enormously increased demands which have grown during the same period, are an indication that in the future mysterious breakdowns will be more rare than in the past.

It must not be forgotten that the voltage of circuits has been gradually increased, the sizes and capacities of machines enormously multiplied, and that during all this period improvements in manufacturing and insulation have been going on by the "weeding out" process; that is, by eliminating weaknesses wherever they have shown themselves. When one thinks of the development of the street railway motor alone and what was necessary to keep it in repair during the first year or two of its existence, as compared with the repair bill now, there is room for any amount of encouragement. At the same time, the cars which are propelled are much heavier and run at greater speed, the braking and stoppage of motion is more sudden, due to improved braking appliances, and yet the motor is, of course, not perfect, though it is difficult to say in what direction any very great advance can be made.

While I agree with the Engineer's remarks in general about the sudden rupture of electrical circuits having a tendency to find the weak spots in electrical machinery, resulting in breakdowns, yet it must be borne in mind that the sudden or gradual rupture of a circuit is not always a matter of choice, for there may accidentally happen a sudden rupture of the circuit without our intending it; thus, a trolley may slip off the wire and suddenly rupture the circuit through the motors on the car; the car may become derailed and thus rupture the circuit; storms may cause lines to be torn down by objects falling upon them and cause sudden ruptures, all of which accidents, if they are to be attended with the breaking down of the dynamos or motors, are made all the more disastrous.

My own feeling is that we shall continue to improve the conditions of installation and the quality of insulation and that sufficient safeguards will be provided for the most sudden rupture of circuits which may be made, and it is to the use of these proper safeguards that I look for the preservation of the machinery from injury. It is true that when a short circuit occurs on the line, conveying enormous energy of current, the quicker a rupture can be made the better, so that the current may not grow to such proportions as to produce damage. This may not be so decidedly the case with alternating currents as with direct, but I think that the safety of the apparatus can be assured, even in the cases of the most sudden rupture, by proper provision of such devices as are employed in the case of lightning discharges. Did we not, in fact, have lightning to contend with as an element of risk of breakdown, it is doubtful whether our improvements in insulation would have been as rapid as they have been. The provision of discharge protectors or lightning arresters is for the express purpose of preventing the insulation of the machine being strained beyond a certain limit, which limit it is supposed to easily stand, and if well constructed generally does stand.

As an instance of what I mean I may say that in our early experience with welding machinery we found that it was entirely beyond our control to prevent occasional ruptures of the heavy current in the secondary circuit, and that this rupture, reacting on the primary of the welding transformer, of course resulted in the production of an enormous voltage, such as would easily leap a considerable fraction of an inch in air. To provide against all possibility of damage from this cause to generators and to transformers, we provided a discharge protector, in a measure similar to a lightning arrester, which was found to be perfectly effective for the purpose, so that no difficulty was ever after experienced from breakdowns of insulation due to sudden rupture of the secondary circuit.

It is my opinion that by employing this principle more largely in electrical installations, the particular elements of danger which you comment upon could be nearly removed, while the improvement in the insulation and the testing of the insulation, conjoined with a proper and intelligent care of the machinery itself (which is naturally often more delicate because it is electrical) will do the rest. I think, also, there is going to be a better understanding on the part of people who have charge of electrical machinery, of just what must be avoided to save the machinery from injury. For example, nothing could be worse for an electrical station than to have it lie idle and the machinery become cold, and subsequently thereto to have a warm humid atmosphere surround the comparatively cold machines. This would lead to the condensation and absorption of moisture, and I have no doubt much trouble has resulted from the existence of such conditions. Incidentally, I may say if street railway managers knew salt to be such a deadly enemy of insulation as it is they would never use it on their tracks.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—VI.

BY LIEUT. B. A. FISKE, U. S. N.

THE SPEED AND DIRECTION INDICATOR.

THE office of this apparatus is to indicate at a distance the speed and direction of revolution of the shaft of an engine, or any other shaft.

The underlying idea is an apparatus which is actuated by the shaft, but has no mechanical connection to it, which operates entirely by itself, and without intervention or care from any outside source; and which has no belting, or gearing subject to slipping, or to wearing out in service.

The speed indicator (direct reading) consists, broadly speaking, of an alternating current system, in which the alternating currents are induced by the rotation of the shaft, being great or small according as the shaft moves rapidly or slowly; and of an alternating current indicator, which indicates the magnitude of the current, and therefore the speed of revolution.

The direction indicator consists also of an alternating current system actuated by the motion of the shaft.

The apparatus is shown in Figs. 18, 19, 20, 21 and 22. Fig. 18 shows both circuits connected to their respective indicators. Mounted on the shaft are two rings, C and C'. Each ring is in halves, which fit the shaft, and these are clamped on, as shown, by lugs at D and D'. (See also Figs. 19 and 20, in which Fig. 19 shows the part pertaining to the speed indicator and Fig. 20 shows the part pertaining to the direction indicator.) Secured on the ring D, or rather on a web that is cast on ring D, are, say, six soft iron inductors, I. These inductors, when revolved by the shaft, pass in front of the poles of the magnet S N. On the poles of the magnet S N are two coils of wire, and these are connected to the alternating current indicator G. When one of these inductors, I, is directly in front of the poles S N, the magnetic flux passing through the two coils is at its maximum. When no iron inductor is near the poles S N, the magnetic flux is at its minimum. As these iron inductors revolve before the poles, consequently the magnetic flux is increased and decreased as many times per revolution as there are inductors. Each increase and decrease of the magnetic flux produces an alternating current in the coils, according to principles well understood, and the more rapid the increase and decrease, the greater the electromotive force induced. It is evident that, in manufacture, it is possible, with a proper construction of the apparatus and with a proper proportioning of the parts, to so control the inductance of the circuit, and to so arrange the inductors and the number of them, that the current in the circuit shall increase very considerably as the speed of the rotation of the shaft increases. In the drawings, the magnet S N is shown as a permanent magnet. Of course it can be an electro-magnet, if desired. If a permanent magnet, the steel must be specially hardened, in order that it may not lose its magnetic strength with age.

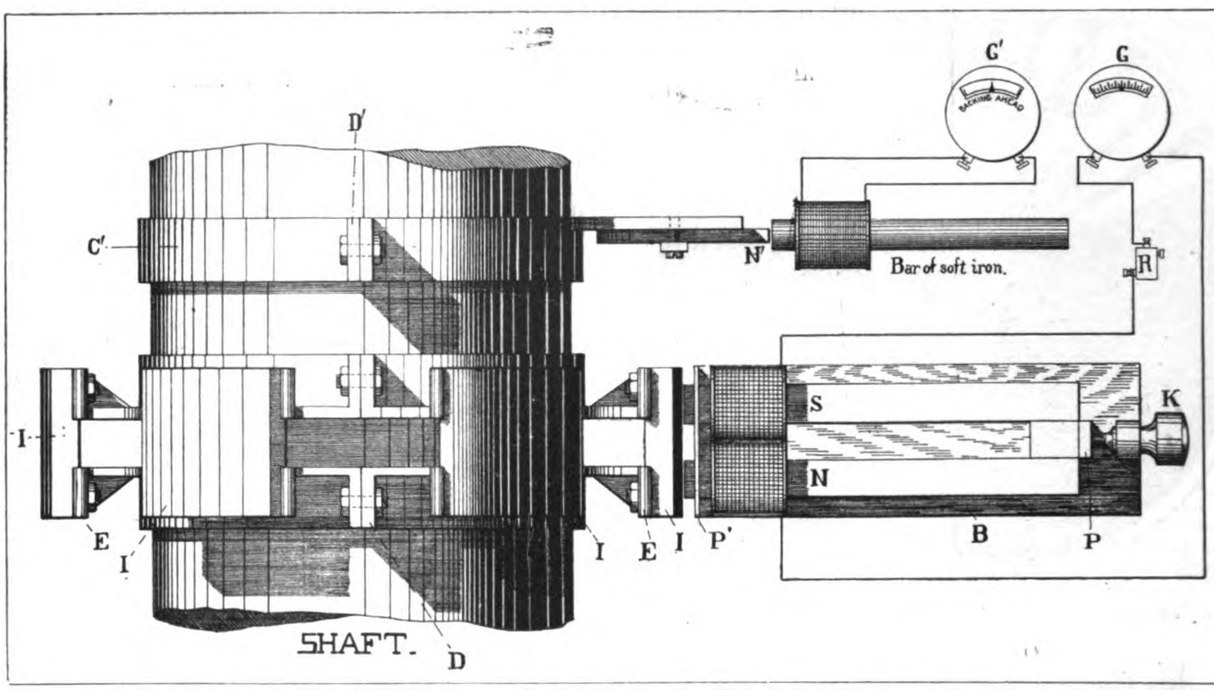


FIG. 18.—LIEUTENANT FISKE'S SPEED AND DIRECTION INDICATOR.

It is advisable, in the construction of the apparatus, to introduce an adjustment for controlling the air gap between the inductors I and the magnet poles N S, and, therefore, the magnetic flux and the strength of the current generated. The adjustment is accomplished by mounting the magnet S N on the two supports P and P', Figs. 18 and 19. By turning the screw K in one direction or the other, the magnet poles are moved longitudinally in the stationary support P', and moved closer to, or further from, the inductors, thus increasing or decreasing, at will, the strength of the currents generated. The usual distance is about 1-16-inch. In installing the apparatus, it is merely necessary to adjust the distance until G indicates correctly.

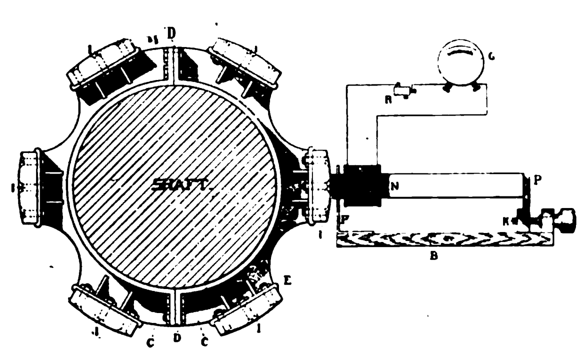


FIG. 19.—LIEUT. FISKE'S SPEED AND DIRECTION INDICATOR.

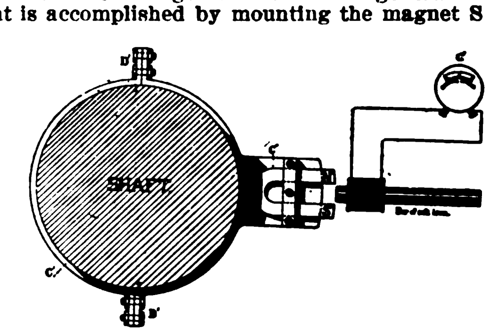


FIG. 20.—SPEED AND DIRECTION INDICATOR.

For making smaller adjustments, the rheostat box R may be mounted near the indicator G. This rheostat box is of the general type used in the range-indicator, and consists, broadly speaking, of a resistance wire wrapped around the surface of an insulating cylinder, so arranged that, by revolving the cylinder, a greater or less amount of resistance may be introduced in the circuit. This adjustment is not always used.

The graduations of the galvanometer G are made empirically

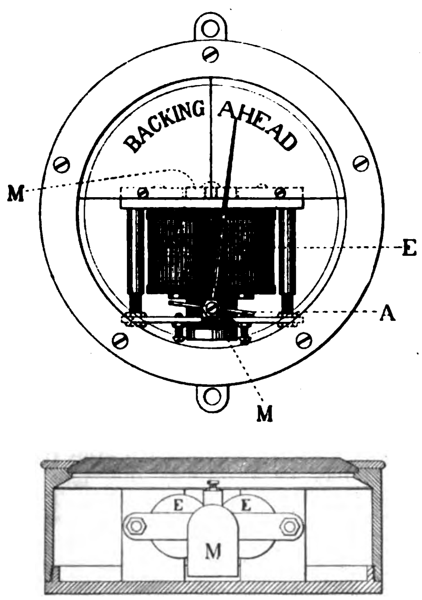


FIG. 21.—LIEUT. FISKE'S DIRECTION INDICATOR.

in manufacture. A shaft carrying the inductors I is run at the various speeds, and the scale of the indicator G is marked with the proper numerals at the places at which the needle stands.

When the speed indicator is mounted on board ship the electrical apparatus of the indicator may be mounted in a water-tight case filled full of a liquid in order to steady the needle. Doubtless many different liquids may be used. Poppy-seed oil is satisfactory; but alcohol mixtures dissolve the shellac on the wire. The galvanometer case is filled from the top, by pouring the liquid through a sort of stand pipe P, Fig. 22, in which it stands at a height somewhat above the case itself. The filling hole in the pipe is closed by a screw plug, and in

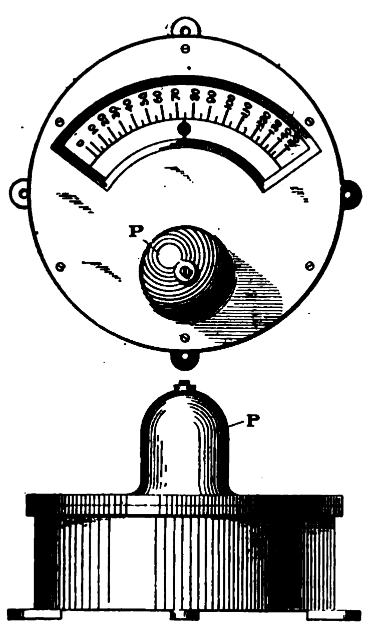


FIG. 22.—SPEED INDICATOR.

this plug is a small hole, which allows the passage of air into or out of the pipe, as the liquid contracts with cold or expands with heat.

The alternating current galvanometer, which is ordinarily employed, is not very different from the direct current galvanometer shown in Fig. 6. But the permanent steel magnet is replaced by a stationary coil of wire which is in series with the movable coil or bobbin. Whenever the current changes in direction, it changes in direction in both the stationary and the moving coil, so that the direction in which the moving coil turns, due to mutual reaction between the two coils, is always the same. Two pairs of volute springs, similar to those in the direct current galvanometer, keep the moving coil, and therefore the needle, at a certain normal position of rest. But any current traversing the coils moves the coil against the springs

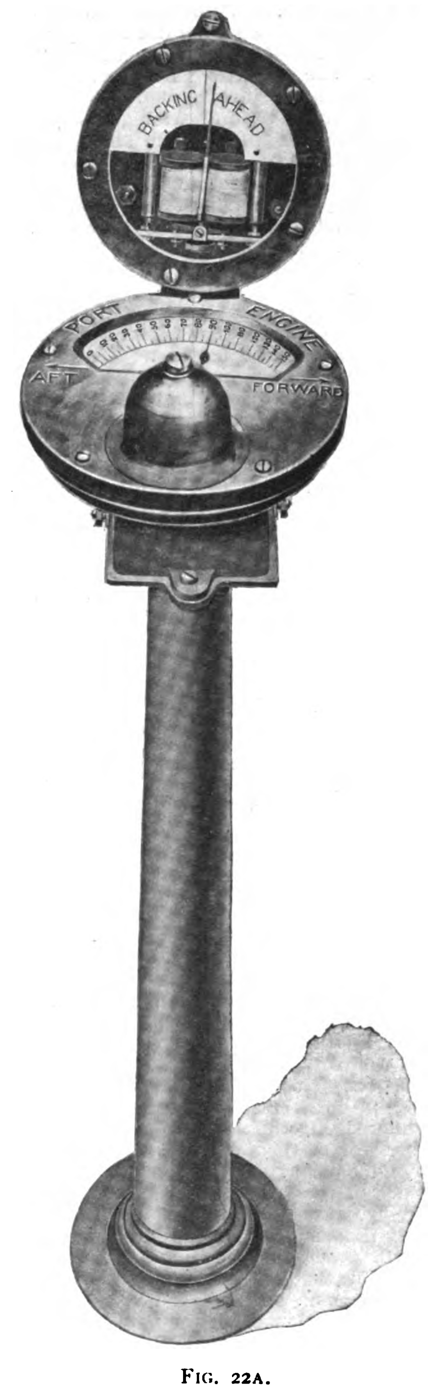


FIG. 22A.

through an angle which depends on the strength of the current.

That part of the apparatus which shows the direction or revolution is shown in Figs. 18, 20 and 21. The magnet N′ S′ is mounted on a projection, C″, secured to the band C′, which is secured on the shaft by means of lugs and screws D′. Mounted near the path traced by the poles N′ S′ in revolving, is a bar of soft iron, on which is a coil of wire connected to a direct current galvanometer, polarized relay, or other current indicator G′, in which a current in one direction causes the needle, or pointer, to move in a certain direction, while a contrary current causes it to move in the opposite direction. Sup-

pose that the shaft is revolving in the direction of the hands of a watch, and that the pole S' approaches the bar of soft iron until directly opposite to it. The approach of this pole will, of course, induce a current of a certain direction in the coil, which current will cause the needle, or pointer, to move, say, to the right, with a quick motion. As the shaft continues to revolve, the pole S' leaves the bar of iron and the pole N' comes up to it. This act induces in the coil a current opposite in direction to that induced by the approach of the south pole, and tends to give the needle, or pointer, a movement, say, to the left. The revolution of the shaft continuing, draws the N' pole from the bar of iron, and this act induces another current in the coil in the same direction as did the approach of S' pole, and, therefore, another movement of the needle, or pointer, say, to the right. The result is, therefore, that at every revolution of the shaft in the direction of the hands of a watch, the needle, or pointer, of the indicator gives quick movements, say, to the right, left, right. If the shaft is moving in the reverse direction, the state of affairs produced is just the reverse of that above cited; so that at every revolution of the shaft, the needle or pointer of the indicator makes quick movements, say, to the left, right, left. By merely looking at this indicator, therefore, an observer sees at once in which direction the shaft is revolving, and he sees also when each revolution takes place. Not only this, but the observer, when he has leisure, can count for one minute the movements of the needle or pointer of G' and see what was the number of revolutions actually made in the minute. The direction indicator is, therefore, a speed indicator also, and may be used as such in case of accident to the direct reading instrument, in connection with which it may always be employed, moreover, as a means of verificaton.

Fig. 21 shows a "polarized relay," such as is used for ringing magneto bells, adapted as a direction indicator. The armature A, polarized (magneitzed) by the permanent magnet, M, is pivoted between the two poles of the electro-magnet E. The alternating currents generated pass through the coils of this electro-magnet and tend to give the armature successive movements right, left, right, or left, right, left, at each revolution. And since there is no directing spring on the armature, and since the magnetized armature when moved to either side tends to remain there, by reason of its nearness to one iron core or the other of the electro-magnet E, the armature remains during the whole time of a revolution, except when the magnet N' S' is actually passing the soft iron bar and its coil, at the position in which it was placed by the last current. In other words, the armature has a certain position of rest which it occupies throughout nearly the whole of a revolution, and which is the position in which it is placed by the last current of the three which are induced by the passage of the magnet N' S' in front of the soft iron bar and its coil.

Furthermore, as the last current, when the shaft is going in one direction, is the reverse of what it is when the shaft is turning in the opposite direction, this position of rest is on one side or the other of its middle position, according as the shaft is going ahead or backing; and as the first current generated in any revolution is the same as was the last current, and as the armature cannot move any farther, the first motion cannot take place except during the first revolution of the shaft.

The result of all this is, that, if the shaft be going ahead, the pointer of the direction indicator, which is attached to the armature, will occupy a position of rest on one side of the scale and will make a quick motion to the left and back at each revolution; whereas, if the shaft is backing, the pointer will lie on the other side of the scale and will make a quick motion to the right and back at each revolution.

The two sides of the scale are marked "Ahead" and "Backing" respectively, as shown in Fig. 21.

The copper wires used in the circuits should not be less in size than No. 16 American gauge.

The speed indicator has been in successful operation on board the U. S. armored cruiser New York for about eleven months, and the direction-indicator in the same ship for about six months. Both are now being installed in the battle-ship Texas, showing in the conning-tower the speed and direction of revolution of both engines; and they are to be installed in the Brooklyn.

RULES FOR SUBURBAN POLES IN WASHINGTON.

The U. S. Commissioners for the District of Columbia have formulated the following order for the overhead system of the Potomac Electric Power Company West of Rock Creek: Poles shall be at least 45 feet high. No span shall be greater than 125 feet. Poles are to be set 9 inches from the outside face of the curb.

All poles are to be stamped or branded with the initials of the company and with number of the pole, not less than 5 feet nor more than 7 feet above the ground.

Cross-arms shall be uniform in length, strengthened by braces, and all wires shall be attached thereto with glass, porcelain or rubber insulators, and must be stretched tightly and fastened with strap of the same kind of wire.

All wires shall be continuously insulated with durable and waterproof material, and this insulation is to be carried to all portions of the circuit, including joints, and is to be kept in constant repair.

No wire shall be stretched within 4 inches of any pole, building or other object without being attached thereto and insulated therefrom.

No line of 500 volts or over shall hang within 20 feet of the surface of the ground at the lowest point.

Every line, pole, fixture, etc., must be kept in order and repair in conformity with these regulations; but no additional poles or wires can be erected under cover of repairs, nor shall the route or location be changed without a permit.

The company shall, upon completion of the overhead line, file with the engineer department plats showing the exact location of the poles and the number and character of the wires strung thereon.

ELECTRIC HEADLIGHTS ON CROOKED ROADS.

The merits of the electric headlight have long since been made familiar, says the "Railroad Gazette." Besides the main function of the light—to illuminate the road for the runner of the engine which carries it—it is a peculiarity of the brilliant arc light, backed by a powerful reflector, that it gives early notice to station men, wayfarers, runners of other trains, tramps and rabbits of the approach of the train bearing the light. In a number of instances this has been strikingly illustrated in the prevention of collisions. The runner using this light cannot see through a hill or a building any better than without it, but by shining above the hill or building the light will make its whereabouts manifest several miles in advance, so that other trains can know that the electrically-lighted train is approaching. The illumination of the particles of dust or moisture in the atmosphere makes a pencil of light which, if the angle of the reflector is properly adjusted, may be seen in the air overhead many miles away, and this often makes an intelligible indication to runners of other trains even if, by reason of a curve in the track between the observer and the point where the light is at that moment, the pencil is some distance away from the line of the road.

Mr. R. C. Vilas, of the National Electric Headlight Company, has recently received a letter from the General Manager of the Cincinnati, Hamilton & Dayton recounting an instance illustrating the value of this feature of the light. An engineman running empty at night, and with the tender foremost, forgot about a passenger train that was due, and would have met it on the bridge over the Miami River at Hamilton, but he saw the light from the electric headlight of the passenger train before the train was in sight; that is, before it had reached a point where it would have been in sight by daylight, or where the lamp could be seen. The careless engineman at once stopped and succeeded in getting into a sidetrack before the passenger train reached him. This was on a road which is by no means free from curves. With the reflector adjusted at such an angle as to throw some of the rays slightly above the horizon the pencil of light in the sky may be made to pass above all ordinary hills and other obstructions, and thus make the light valuable on a crooked road as well as on straight lines. Enginemen on the Cincinnati, Hamilton & Dayton, as well as on the roads of the Western prairies, assert that they would pay for the lamps themselves rather than do without them.

FAREWELL REPORT OF THE BROOKLYN SUBWAY COMMISSIONERS.

In retiring from their now extinct offices as Subway Commissioners in Brooklyn, N. Y., Prof. G. W. Plympton and Mr. F. R. Lee have filed a farewell report with Mayor Wurster. It contains a number of interesting details. The figures as to wires in that city on October 1 are as follows:

	Miles.
Aggregate length of electric conductors of all kinds within city limits	21,957
Increase during this year	1,586
Total length of wires underground or suspended from elevated railways is	14,248
Increase since January 1	1,939
Total length of underground conduit is	136
Length of single duct	377

Sixty-five per cent. of all electrical conductors within city limits are under the streets or suspended from the trusses of the elevated roads, or, excluding the city's wire's from the estimate, 69 per cent. of all wires under the jurisdiction of this board are thus disposed of.

The subject of corrosion of underground pipes and cables still demands serious consideration. The survey made in 1894 of the electrical condition of the districts traversed by the trolley lines was not continued in 1895, for the reason that the Nassau trolley system was in process of construction, and the whole problem of underground currents was assuming larger proportions and presenting new complexities. As the new lines were practically completed early in the present year a new survey was made during the summer under the direction of Mr. John A. Barrett. This survey included numerous examinations of the water pipes which could only be made by excavations in the streets. In this work this board received the efficient and hearty co-operation of the department of city works. Excavations were made wherever it was deemed desirable to make a direct examination of the water main.

One gratifying conclusion was arrived at as a result of this thorough examination, and that was that in the districts where underground pipes are most liable to destruction by electrolysis the cast iron water mains remain intact. Wrought iron and lead pipes deteriorate steadily and rapidly, in places where cast iron shows no sign of decay. The statement in a former communication from this board that the water system of the city was seriously endangered and probably already impaired by electrolytic corrosion, now requires modification to the extent that such injury is confined to such branches as are constructed of wrought iron or lead. The immunity from injury by the ordinary process of oxidation, possessed by cast iron was long since pointed out by engineers, one of whom declared that it was his belief that the so-called white casting is practically indestructible under the action of ordinary oxydizing influences.

It would seem likely, therefore, in view of the perfect preservation of the water mains under conditions that lead to the destruction of wrought iron and lead pipes that, whether through design or not, the large pipes have been made of a quality of iron that insures their safety. The inconvenience and loss resulting from the electrolytic corrosion is not limited to the destruction of the pipe or cable covering. From the corrosion of gas pipes there results a leakage of gas which destroys trees, threatens the health of the neighborhood and increases the danger of explosions in manholes and cellars. The corrosion of water pipes leads to waste of the city's water supply, while the destruction of the buried electric cables tends to seriously limit the area within which electric conductors can be successfully operated in subways. Moreover, the destruction of either kind of so-called service pipe, whether delivering water or gas, calls for frequent disturbance of the street pavements. In some places service pipes extending beneath the trolley tracks have been repeatedly destroyed and removed, each removal of course requiring an excavation, refilling and a relaying of the pavement. It should be here stated, however, that destruction of the underground pipes is not limited to the streets occupied by the trolley lines. The trolley companies have during the year done much to keep the destructive current on the path of their own conductors so that the injury is doubtless less rapid than it was two years ago, but a means of absolute prevention of the injury so long as the pipes are of a kind liable to corrode, is not yet made known. The escape to the earth of a portion of the current discharged into the rail is a condition inseparable from the single trolley system. Non-metallic service pipes for conveyance, both of gas and water, are plainly desirable in the present emergency.

The total length of electrical conductors within the city limits when this board began its work in June, 1892, was in round numbers 9,800 miles, of which about 6,000 was on poles or house tops. Comparing these figures with the totals given above, it is shown that the increase in the length of wires during the existence of the board has been about 12,200 miles, of which amount somewhat over 10,200 miles have been provided for in conduits or on the elevated railways. One hundred and eighty miles of conduit containing 280 miles of single duct have been constructed in the same period.

NON-HYSTERETIC IRON FOR TRANSFORMER PLATES.

In dynamo electric apparatus there is in those parts of the iron core where the magnetic flux is varying—even where Foucault currents are suppressed by laminating it—a loss of energy due to hysteresis, which appears as heat in the iron and is called "core loss." It has been known for some years that this core loss in annealed iron cores, which become heated while the apparatus is in use, increases after such use has continued for some time, the increase being due to an increase in hysteresis. This increase in hysteresis accompanies long continued heating, such as that produced by the reversal of the lines of force in uncooled transformers as now ordinarily constructed. If the heating of the iron could be prevented, the increase of the hysteresis and resulting increase of core loss could also be prevented, but the cost of prevention of heating is such as to make it commercially impossible. Hence the increase of core loss has up to the present time been submitted to as a necessary evil. This evil is marked in alternating current dynamos and motors, but is probably greater in transformers than in other kinds of electrical apparatus. Its magnitude in transformers will be plain from the following figures: The average size of transformers at present is fifty lights, being such a transformer as would be used to light a large sized dwelling house of fifteen or twenty rooms. The average all-day load is quarter load, making its average output about seven hundred watts. The core loss in such a transformer, when new, will at a frequency of one hundred and thirty-three alternations per second be about 55 watts. After the transformer has been in use under ordinary conditions for some time there is, as above stated, an increase in the core loss due to hysteresis. This increased core loss in a comparatively short time amounts to at least 40 per cent., and later frequently rises to 100 per cent. of the original core loss. Taking it at only 45 per cent. it will in this case amount to about 25 watts, or over 3½ per cent. of the average output; that is to say, the average efficiency of the transformer will be reduced about 3½ per cent. To put it another way, the steady losses in a 10,000 light central plant installation would be increased by some 5 kilowatts, which, at the low rate of 1 cent per kilowatt hour, would cost the producer $1.20 a day, or $438 a year.

Heretofore, although the increased core loss has been recognized, all attempts to prevent it by changing the composition or character of the iron have been attempts to make a purer iron to exclude as far as possible all foreign substances. Mr. John F. Kelly, of the Stanley Electric Mfg. Co. of Pittsfield, Mass., however, has discovered that the hysteresis growth which gives rise to the increase of the core loss can be prevented by intentionally having the iron of the core contain one foreign substance such as silicon in suitable proportions. One proportion suitable for attaining the object is 0.0235 per cent. of silicon, the other parts being pure commercial iron.

The amount of silicon in the iron used by Mr. Kelly, it will be noticed, is considerably larger than that present in the ordinary iron used for laminated cores. The abnormal amount of silicon in the iron does not increase the original core losses in perfectly annealed iron, but prevents the hysteresis growth at the temperatures to which the transformers are subjected when in use. The iron with the hysteresis growth-preventing silicon alloy is more springy than iron ordinarily used in cores, in addition to being more difficult to anneal. The alloy appears to resist molecular change of any sort.

THE TESTING OF HEAVY INSULATORS.

BY NEVIL MONROE HOPKINS.

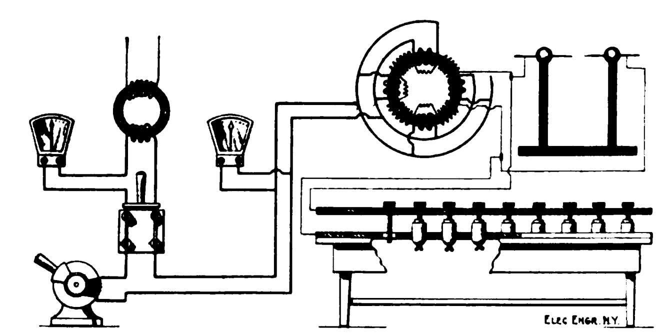
The testing of heavy insulators designed for high tension service is of great importance before their shipment and installation. Delicate measurements of resistance would mean very little as no reliable information concerning the future behavior of the insulator when put in actual use would be gained, for leaks would develop and defects come to the surface when put under the strain of the high tensions employed in certain classes of railway work and long distance power transmission. The actual "break down" test is based on the theory that an insulator which is able to resist puncture when submitted to a tension of 30,000 volts for a period of thirty or forty minutes is capable of effectually insulating a current with a potential difference of 1,000 or 2,000 volts for an indefinite period. Is it altogether wise to submit a porcelain insulator to such an abnormal stress?

It would undoubtedly be preferable not to do so if gentler means were at hand to learn of its collapsing point. In the case of the hydraulic testing of steam boilers which are never benefited by an abnormal test pressure, the same argument may be applied. In either case heroic methods appear to be the only practical courses, and perhaps after rejecting those insulators which become at all heated during the test a reliable knowledge of their insulating qualities can be reached.

The accompanying diagram shows the arrangement of apparatus best adapted to this special test. Alternating current is received at the first transformer at 1,000 volts and it is stepped down to 100 volts before the indicating instruments are connected in and the primary of the high transformer fed. Should this step down be omitted, any accident to the high potential transformer, such as a short circuit between its primary and secondary, would put the alternator in danger.

A "choking" or controlling coil is included in the circuit with the ammeter, and after crossing the terminals of a voltmeter the conductors are led directly to the high potential transformer, as shown in the diagram. Here the voltage is stepped up from 100 volts to 30,000 volts by means of the single, wire ring transformer. The table on which the insulators are placed is provided with a copper, or sheet iron top with holes punched through to receive the insulators. Wooden strips with copper covered tops carry the metal bolts that drop through and rest on the bottom of the insulator. A hard rubber or wooden stand carries copper needles which may be easily adjusted.

In the present case, the needles are separated one and one-half inches and a discharge will take place across the air gap should the voltage rise above 30,000. A loud humming noise begins on closing the circuit, accompanied by a strong odor of ozone until an insulator breaks down under the stress and



Method of Testing Large Porcelain Insulators.

begins to sing at a low pitch until it cracks and heats up to a red heat in the neighborhood of the puncture. Any defects in the moulding of the clay, or any conducting mineral that may be present, immediately starts a slow leak that frequently ends in puncture.

A loss of from 8 to 10 per cent. is usual in carefully made insulators, when subjected to 30,000 volts. Insulators that contain some conducting mineral in the clay frequently begin to leak within five or ten minutes and a regular conducting passage seems to form which raises the temperature of the whole insulator without doing any apparent damage. Specimens which behave in this manner are frequently overlooked in the test, for they do not puncture and sing, and it hardly need be mentioned that they should not be passed as perfect. Those that remain cold during the thirty minutes are as near perfect as can be detected.

OBITUARY.

ELBREN S. BOWERS.

The body of Mr. E. S. Bowers, who disappeared suddenly from his home at Evanston, Ill., on the evening of Sunday, October 25, was discovered floating in Lake Michigan at the foot of Main street, South Evanston, on November 2. Mr. Bowers, who carried on the business of Bowers Bros., dealers in mica, at 119 Lake street, Chicago, for the past eight years, was the surviving member of the firm. He attended the American Street Railway Convention at St. Louis the week before his disappearance, where the firm had an exhibit in conjunction with the Central Union Brass Company, of St. Louis, and appeared to be in his usual health and good spirits. On his return to Chicago he complained to his mother, Mrs. Mary Bowers, with whom he resided, of not feeling well, and was worse on Sunday and left the house while Mrs. Bowers went to dress to go out for a walk with him. From there he went to a drug store in Evanston, and it is believed that he then walked down to the end of the new breakwater and threw himself into the lake. Mr. Bowers had suffered from an affection of the mind some years ago after an attack of grippe, and had been in an asylum for a short period, and it is surmised that he had a return of the old symptoms, which led to his committing the sad act.

He was 35 years old, unmarried and carried on his business in a very successful manner. He was a man of most genial disposition and of the highest integrity, and his untimely death will be greatly regretted by his numerous friends. His remains were removed for interment to Ackwood, N. H., on November 4.

W. L. CORTHELL, the superintendent of the Derry, N. H., Electric Light Company, has died of typhoid malarial fever.

SOCIETY AND CLUB NOTES.

LAYING THE CORNERSTONE OF THE COLUMBIA ENGINEERING BUILDING.

The cornerstone of the Engineering Building, at the new site of Columbia University was laid on Wednesday, November 4. Addresses were made by President Low and Henry S. Monroe, E. M., Ph. D., professor of mining, and the benediction was pronounced by Bishop Littlejohn, of Long Island. The cornerstone was laid by Francis B. Crocker, Ph. D., professor of electrical engineering. At the same time was laid the cornerstone of Havemeyer Hall, the building generously given to the chemical department of the university by the Havemeyer family. These, together with the Low Library, Physics Building, Schermerhorn Hall (Natural Science) and the University Hall, will be completed in time for occupancy next October, when the university will open its new home. Other buildings will be added later, as demands for space increase. The admirable design and arrangement of this collection of buildings will secure a maximum of convenience and effectiveness, which is not possible when the separate buildings are erected by different architects at long intervals of time. Some idea of the scale of the new Columbia may be gathered from the fact that the electrical generating plant will have 750 horse-power capacity to start with, and will be increased later.

THE ELECTRICAL SOUND MONEY CLUB AND ITS PARADE.

We print below the general order No. 2, just issued by Gen. C. H. Barney, as marshal of the electrical brigade in the sound money parade, described fully in The Electrical Engineer last week:

"Electrical Sound Money Club—Headquarters Electrical Brigade.

"New York, November 2, 1896.

"General Order No. 2.—The marshal of the electrical brigade in the business men's parade of the 31st ultimo hereby returns thanks to all those who took part in that splendid demonstration as members of this command.

"He desires first to acknowledge his great obligations to the officers of the Electrical Sound Money Club for their cheerful and hearty co-operation and support in the work of preparation, and for the inspiration afforded by their presence at the head of the column during the parade.

"In thanking the various organizations of the brigade whose fine appearance and good marching were the subject of so much favorable comment, he feels that as all deserve praise, it would be invidious to compliment any particular organization; officers and men all did well. He deems it proper, however, without derogation to the services of the other regimental commanders, to call attention to the fact that Col. Frank M. Anderson, commanding the second regiment in the brigade, is deserving of great credit for the ability which he displayed in organizing and instructing his command, with less than forty-eight hours for that purpose, so that in appearance and marching it was not surpassed by any battalion in the brigade.

"The marshal heartily thanks the members of his staff for their great assistance in the work of preparing and handling the parade, and desires especially to acknowledge the valuable services of George F. Porter, chief of staff; Edward P. Decker, brigade engineer, and Aides F. S. Blackall, Paul A. Ferry and E. T. Rice. C. H. BARNEY, Marshal."

THE ELECTRICAL SOUND MONEY CLUB.

Before the great parade for "sound money" in New York City on October 31 passes into history it is only proper to accord due credit to the Electrical Sound Money Club, which organized the electrical brigade, as described by us last week. The success must be very largely ascribed to the efforts of Mr. Charles Blizard and Mr. S. L. Coles, both of whom worked very hard, and gave a great deal of time and thought to the matter. The officers of the club were Gen. E. S. Greeley, president; U. N. Bethell, A. S. Brown, F. W. Jones, F. A. Pickernell, S. S. Wheeler, Charles Blizard, A. L. Salt, vice-presidents; S. L. Coles, secretary; W. L. Candee, treasurer. The subscriptions from the trade and profession were liberal, and the whole thing reflects the greatest credit upon those engaged in it.

THE AMERICAN INSTITUTE OF ARCHITECTS, at its thirtieth annual convention at Nashville, Tenn., voted to continue to be represented in the conference having in charge the establishment of standard electric rules.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Alternating Current:

INFLUENCE OF INSTALLATION RESISTANCE AND CAPACITY IN ALTERNATING CURRENT INSTALLATIONS ON POTENTIAL AGAINST THE GROUND.—By A. V. Ettinghausen and G. Ossanna. Authors explain methods for testing insulation by means of electrostatic voltmeters and show diagramatically various effects on various lines. "Zeitschr. f. Elektrotechn." Sept. 15, '96.

WORKING ALTERNATORS IN PARALLEL AT HASTINGS.—Mr. L. Andrews has devised a simple method for running the alternator in his station at Hastings in parallel. The sketch of the arrangement on the switchboard is necessary for a clear understanding and is to be found in the "Engineer," Oct. 9, '96.

Central Stations:

THE CENTRAL STATION AT ZURICH.—By Ch. Jacquin. A detailed illustrated description in "L'Eclairage Electrique." Sept. 12, '96.

Dynamos and Motors:

SPARKING IN ARMATURES.—By J. Fischer-Hinnen. Determination of formulæ for calculating the distance of the brushes from the neutral point. Different types of armature windings are considered. "Electrotechn. Zeitschr., Sept. 17, '96.

Electro-Chemistry:

ELECTROLYTIC PREPARATION OF A NEW CLASS OF OXYDIZABLE MATERIALS.—By E. J. Constam and A. von Hansen. An exhaustive study with potassium carbonates.

Electro-Physics:

ELECTRIC POTENTIAL IN MOVING LIQUID.—By G. Gouré de Villemontée. Author reviews the history of this investigation, which was started as early as 1871, and gives account of his own work. It has usually been observed that a difference of potential exists between two points in a liquid. "L'Eclairage Elec." Sept. 12, '96.

Measurements:

MIRROR GALVANOMETERS.—By Dr. Hilmar Sack. A Deprez d'Arsonval galvanometer investigated by Dr. Classen and published in detail on page 676 of the "Electrotechn. Zeitsch.," 1895, is shown by the author to cause inaccuracies in several details. An improved form manufactured under the author's supervision by Siemens & Halske, is described in "Elektrotechn. Zeitschr.," Sept. 17, '96.

ELIMINATING MAGNETIC DISTURBANCES IN THE SENSITIVE GALVANOMETER.—By Dr. A. Raps and Dr. A. Franke. Besides the arranging of iron wire bundles outside of the instrument, two small supplementary very weak magnets were attached to the movable system and used to make the needles perfectly astatic. "Elektrotechn. Zeitschr." Sept. 17, '96.

ELECTROSCOPE WITH THREE GOLDLEAVES."—By L. Benoist. Three goldleaves are suspended side by side at the lower end of the isolated metal rod; when these become charged the middle one will keep its vertical position, while the two others will diverge outward. The sensitiveness is increased with small angles in a ratio of about 3 to 2, and still more favorable in large deflections. "Compt. Rend.," page 171, '96.

BALANCE FOR ABSOLUTE MAGNETIC MEASUREMENTS.—By Dr. Karl Strecker. Description accompanied by drawings to illustrate to the student the methods of determining magnetic movements and the absolute number of lines of force. "Zeitschr. f. d. Phys. & Chem. Unterr.," Sept. '96.

SIMPLE MODEL OF AN INFLUENCE MACHINE.—By K. W. Dubrowsky. Description of a simple piece of apparatus which for a small outlay can be made of sufficient strength to light up a Geissler tube or charge a Leyden jar. "Zeitschr. f. d. Phys. & Chem. Unterr.," Sept. '96.

Railways:

TRAMWAY STATISTICS IN FRANCE.—Details of several roads are tabulated in "L'Eclair. Elec.," Sept. 26, '96.

ACCUMULATIONS ON STREET RAILWAYS.—The storage battery, which has been running in Hanover for one year is said to be a success in the "Zeitsch. f. Elektrotechn.," Oct. 1, '96.

Telephony, Telegraphy, etc:

ELECTRIC SIGNALS OF THE VIENNA FIRE ALARM SERVICE.—By Willy Chitil. A description of the entire system where, among other devices, methods for calling the volunteers are employed. "Zeitschr. f. Elektrotechn.," Oct. 1, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 3, 1896.

Alarms and Signals:—

ELECTRIC ALARM BELL. R. Segerdahl, Chicago, Ill., 570,508. Filed June 27, 1892.
Details of construction.

BURGLAR ALARM. F. Steinkoenig, Sioux City, Iowa., 570,616. Filed June 12, 1896.
Means for giving notice in all of the apartments excepting that into which the burglar has broken.

TRACK INSTRUMENT. T. B. Dixon, Henderson, Ky., 570,700. Filed Sept. 12, 1895.
For transmitting signals.

Batteries, Secondary:—

PROCESS OF MANUFACTURING PLATES FOR SECONDARY BATTERIES. C. H. Weise, Possneck, Germany, 570,619. Filed April 4, 1895.
Consists in confining a pasty mass of lead compound in an acid proof frame having perforated sides, passing cellulose threads through the perforations of the frame, placing the same in an acid bath, passing an electric current through the same, and finally exposing the formed hardened plate to the action of the air to destroy the chemically changed cellulose.

Electro-Metallurgy:

ELECTRODEPOSITION. E. Jordis, Munich, Germany, 570,554. Filed June 29, 1896.
Consists in preparing a bath containing the lactate of the metal to be deposited, and then precipitating the metal by means of an electric current.

Lamps and Appurtenances:—

INCANDESCENT LAMP SOCKET. A. Swan, New York, 570,517. Filed Jan. 23, 1896.
Embodies a removable base.

ELECTRIC ARC LAMP. H. A. Seymour, Washington, D. C., 570,823. Filed July 1, 1896.
Alternating current lamp of the enclosed arc type.

ELECTRIC ARC LAMP. H. A. Seymour, Washington, D. C., 570,824. Filed July 7, 1896.
Similar to above.

CARBON FOR ARC LAMPS. D. A. Sheeler, Toledo, Ohio, 570,825. Filed Feb. 18, 1896.
Consists of graphitoid silicon asbestos, carbon, and a binder.

GLOBE FOR ELECTRIC ARC LAMP. M. B. Bailey, Chicago, Ill., 570,446. Filed July 11, 1894.
One part of the globe is opaque and provided with series of reflecting corrugations.

BRACKET FOR PENDENT ELECTRIC LIGHT GLOBES. J. Christiansen and R. W. Pittman, Hartford, Conn., 570,452. Filed Jan. 5, 1895.
Comprises a suspension member; a weight secured thereto for adjustment directly below or laterally of the suspension member, and means carried by the weight and adapted to support a lamp.

STREET LAMP HANGER. H. P. Hill, Washington, D. C., 570,801. Filed Dec. 6, 1895.
Comprises a lamp rope provided with an enlargement, a bifurcated pawl, embracing the rope, and inclined tracks adapted to direct the enlargement upon the lamp rope away from the pawl.

Miscellaneous:

GALVANOMETER. C. Coleman, Chicago, Ill., 570,454. Filed June 9, 1896.
Comprises a pivoted armature and a magnet having pole-pieces provided with overlapping portions whose opposing surfaces are parallel and concentric with the axis of motion of the armature.

INSTRUMENT FOR MEASURING ELECTRIC CURRENTS. R. M. Hunter, Philadelphia, Pa., 570,481. Filed Oct. 4, 1892.
Employs a wire under tension through which a small current is caused to flow, and in its expansion and contraction acts upon a pivoted needle traversing a scale.

Miscellaneous:—

MAGNETIC SEPARATOR FOR THRESHING MACHINES. E. H. Osborne, Des Moines, Iowa, 570,496. Filed Jan. 24, 1896.
Magnets are employed to arrest a metallic body in passing through the machine and means are provided for sounding an alarm.

ELECTRICALLY CONTROLLED ELEVATOR. S. D. Strohm, Philadelphia, Pa., 570,827. Filed April 4, 1896.
Means to prevent the operation of elevator when any of the landing doors are open.

TOWINGAPPARATUS . A. De Bovet, Paris, France, 570,839. Filed April 5, 1894.
Means to convert carrying barges into tow boats capable of being towed individually along a chain sunk beneath the water. The chain passes over a magnetized pulley.

ELECTROMAGNETIC WARP STOP-MOTION FOR LOOMS. A. C. Shuttleworth, Philadelphia, Pa., 570,738. Filed April 30, 1894.
Details of construction.

Railways and Appliances:—

TROLLEY. J. A. Hance, St. Louis, Mo., 570,475. Filed Feb. 26, 1896.
Comprises two grooved wheels mounted in a frame, two smaller grooved wheels also mounted in the frame in a running line with the others, the frame being pivotally mounted on the trolley pole.

ELECTRIC RAILWAY. H. C. Reagan, Jr., Philadelphia, Pa., 570-565. Filed March 11, 1896.
A conduit system in which magnets are employed to actuate the contacts carried by the car.

MAGNETIC PATH FOR UNDERGROUND ELECTRIC RAILWAYS. H. C. Reagan, Jr., Philadelphia, Pa., 570,566. Filed April 21, 1896.
Comprises a conduit, a casing, a series of independent magnetic paths, supported above the conduit, and a magnet having soft iron shoes attached to each pole, the shoes extending over one or more magnetic paths.

RETURN CIRCUIT FOR ELECTRIC RAILWAYS. G. Kapp, Berlin, Germany, 570,599. Filed Dec. 31, 1895.
Insulated return feeders connected to the track at points remote from the power station, and auxiliary sources of electromotive force inserted in the return feeders to decrease the difference of potential.

Regulation:—

METHOD OF AND APPARATUS FOR REGULATING DYNAMO ELECTRIC GENERATORS AND MOTORS. J. W. Easton, Brooklyn, N. Y., 570,663. Filed April 1, 1892.
A circuit controlling device actuated by vibrations in the output of the machine for varying polarity of one set of pole pieces independently of the others.

MULTIPLE SERIES CONTROLLER. J. F. McElroy, Albany, N. Y., 570,878. Filed Aug. 28, 1894.
A frame having a positive and negative pole, a means for conducting the electricity in multiple series, a means for breaking the circuit forcibly and abruptly and simultaneously unlocking the controller.

Switches, Cut-Outs, Etc:—

SAFETY SWITCH. E. Jokl and W. M. Christian, Vienna, Austria-Hungary, 570,808. Filed Aug. 14, 1896.
Apparatus for throwing automatically into circuit reserve lamps or motors in place of such apparatus which have been damaged so that the current cannot pass through them.

AUTOMATIC SAFETY DEVICE FOR ELECTRIC CIRCUITS. L. G. Rowand, Camden, N. J., 570,882. Filed Sept. 13, 1895.
Particularly adapted for trolley lines in streets.

Telegraphs:—

TYPE PRINTING TELEGRAPHIC APPARATUS. F. H. W. Higgins, London, England, 570,852. Filed Oct. 11, 1895.
Details of construction.

Telephones:—

TELEPHONE SWITCH. C. N. Sandbeck, Harmony, Minn., 570,773. Filed April 8, 1896.
For use in connecting two telephones of a series.

AUTOMATIC TELEPHONE SYSTEM. M. Brooks, Minneapolis, Minn., 570,840. Filed Jan. 26, 1895.
Means whereby subscribers may call and talk with one another without the interposition of a central switchboard.

SUBSTANCE FOR TELEPHONE ELECTRODES. D. Drawbaugh, Eberly's Mill, Pa., 570,845. Filed Jan. 10, 1896.
Composed of a substance having its surface covered with platinum black.

REPORTS OF COMPANIES.

DRAWBAUGH TELEPHONE CO.

At the annual meeting of the stockholders of the Drawbaugh Telephone and Telegraph Company, held at the office of the company, No. 2 Wall street, New York City, President Bartlett spoke at length regarding the bill now pending before Congress, removing the technical bar of two years' public use, which was imposed upon Drawbaugh by the ruling of the Commissioner of Patents. The address was delivered in view of the fact that some public misapprehensions might exist, owing to recent dispatches from Washington regarding the action of the Court of Appeals, which a few days ago affirmed the decree of the Commissioner of Patents "turning down" Drawbaugh. The following were elected directors: John R. Bartlett and H. C. Andrews, of New York; Hon. Frank Jones, New Hampshire; Parker C. Chandler, Boston; Col. J. F. Stokes, Philadelphia; Hon. James Jourdan and Abel E. Blackmar, Brooklyn. The officers of the company expressed confidence from assurances they have received, that the ultimate outcome of the government suits will be favorable to the Drawbaugh Company, and that the bill now pending in Congress will be passed.

WINDING UP THE ELECTRICAL EXPOSITION.

The National Electrical Exposition Company, through its directors, George F. Porter, Edward F. Peck, and others, has applied to the Supreme Court for the voluntary dissolution of the company, and Judge MacLean has set down the order to show cause for Feb. 1, 1897. The company was incorporated on Nov. 25, 1895, with a capital stock of $10,000, of which $2,000 was paid in, for the purpose of keeping for a short period an electrical exposition or display. The object has been accomplished, and there is no longer any necessity for continuing its corporate life. The enterprise was financially successful, the company is entirely solvent, has a surplus in the treasury, and no creditors. The assets consist of cash $764, and accounts receivable $577.

LEGAL NOTES.

A DECISION ON TROLLEY SPEED IN BROOKLYN.

Civil Justice Neu, of Brooklyn, recently imposed a fine of $25 on the Nassau Electric Railroad Company for an alleged violation of the trolley speed ordinance. The company took an appeal to the County Court, and now Judge Hurd has handed down a decision reversing that of Justice Neu.

He holds that the city must prove wilful and negligent violation of the ordinance and that stopwatch timing of a run of 300 feet is not sufficient. More than sixty similar suits against the trolley companies are pending. The city will probably appeal from Judge Hurd's decision.

SUIT AS TO TELEPHONIC SWITCH PATENTS.

A bill in equity has been filed by the Western Telephone Construction Company, of Chicago, against the Philadelphia Standard Telephone Company, Joseph H. Mann, president; Richard W. Clay, treasurer, and W. Frederick Snyder, general manager, and the Union Traction Company, and Allen T. Nye, all of Philadelphia, and the Standard Telephone Company, of New York, alleging infringement of patent.

It is alleged that Henry M. Fisk was the original inventor of an improvement in combined annunciator and spring jack, for which he obtained a patent, and which he subsequently assigned to the plaintiff, giving the latter exclusive use thereof. The defendants are, it is alleged, using and selling telephone switchboards, infringing on the patented inventions named. The Court is asked to enjoin them from doing so.

THE BELL TELEPHONE ARGUMENT began on Monday in the United States Supreme Court.

PERSONAL.

MR. GEORGE HELI GUY, the secretary of the New York Electrical Society, has returned from a two months' trip to England, and is busily engaged laying out an attractive winter programme for that popular and successful organization.

NEWS AND NOTES.

JAMAICA, N. Y.—The Jamaica Electric Light Company advises us that it is building a new plant. Its present system is Ball arc and Stanley incandescent. The officers are W. S. Williamson, president; W. T. Goundie, vice-president; O. L. Schwencke, secretary and treasurer; J. N. Williamson, superintendent and manager.

MORAVIA, N. Y.—The Moravia Electric Light, Heat and Power Company, owing to low water power, has, it informs us, bought a 125 horse-power engine. The officers are W. J. H. Parker, secretary, and W. Fitts, treasurer.

OWOSSO, MICH.—The Caledonia Electric Light and Power Company has absorbed the Owosso Electric Light Company, and has had plans drawn, it informs us, for a two-story brick addition to its station. The apparatus is General Electric, Triumph and Westinghouse. John L. Ralph is president, I. D. H. Ralph treasurer and general manager. The company is running three cars for the Owosso and Corunna Traction Company.

WINONA, MINN.—The Winona Railway and Light Company informs us that it has now elected as its officers C. A. Severance, president; M. B. Webber, secretary; F. A. Seymour, treasurer; S. B. Livermore, general manager. The company has a Thomson-Houston railway system, and Thomson-Houston, Edison and Westinghouse lighting, twelve dynamos in all. The converters are Wagner and Elkhart. About 100 horse-power c. f. motors are run and five cars. The power plant comprises five engines, one Buckeye, two Ball & Wood, one Ball and one Ideal.

LITTLESTOWN, PA.—The Leber Electric Company, L. H. Leber, manager, is in the market for the equipment of two plants, one 30 kilowatt alternating and one 250 arc. The company has a large amount of lighting contracted for.

NEWPORT, N. H.—The Newport Electric Light Company is reported by M. W. Tenney, superintendent, to have a contract with the town for five years for twenty arc lights and twenty-two incandescents for street lighting. The plant is run by turbines of 175 horse-power. There are one 45 arc lighter, 1,200 c. p.; one 35-light and one 60-light alternating, and twenty miles of circuit. S. M. Richards is president and W. F. Richards treasurer.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE AMERICAN ELECTRIC METER.

UNDER this name the American Electric Meter Company, Betz Building, Philadelphia, Pa., of which Prof. W. D. Marks is president, have just brought out a type of mechanical meter which, it is claimed, overcomes the difficulties which have been experienced in the past with this class of apparatus and which, besides being economical in current consumption, requires no electrical knowledge for its erection and operation.

The accompanying engravings show, respectively, the meter closed and with the case open, exposing the mechanism. The meter consists in the 3-wire system of two solenoids and cores placed above a self-starting pendulum actuated by the electric current. The pendulum, by means of a cam, raises a pawl on a ratchet wheel to a uniform height each stroke. The solenoids, by means of their cores, shift the angular position of a pendant arch attached to their axis so as to permit this pawl to drop along the ratchet wheel a number of teeth proportional to the current passing through the meter; thus at each stroke of the pendulum the load in amperes passing to the consumer is by means of the ratchet wheel and the dial register, measured and added up in ampere hours. A pointer and scale show through the glass the amperes passing. The interior mechanism is supported by a brass frame, similar to that of a Yankee clock, and the case is cast iron, thus acting as a magnetic shield and preventing tampering with the meter by means of magnets on the outside.

FIG. 1.—THE AMERICAN ELECTRIC METER.

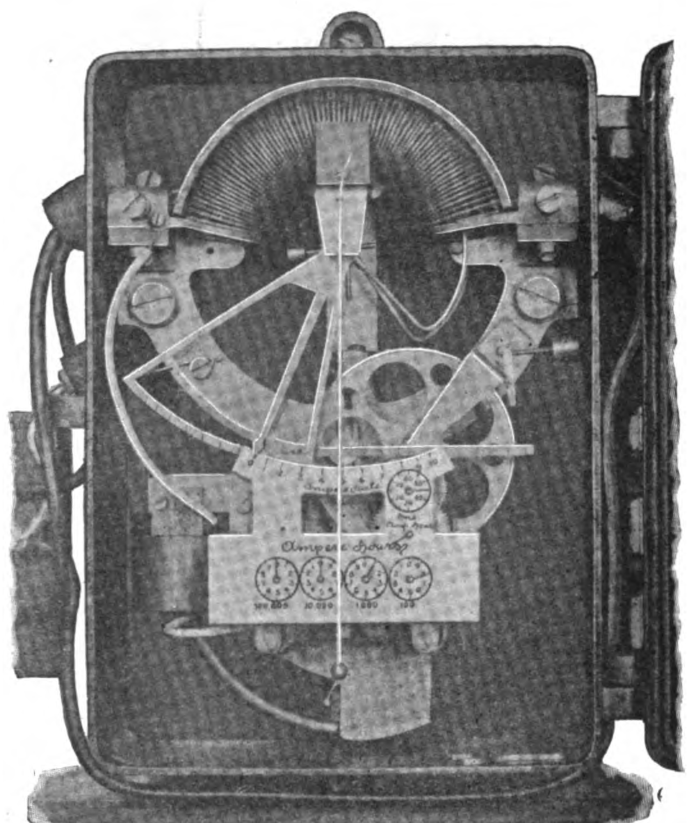


FIG. 2.—THE AMERICAN ELECTRIC METER.

As to the accuracy of the meter, a series of observations taken at random from a large number of experiments, covering more than a year's work, showed the variations in the solenoids of the manufacturer's model to involve no greater average error than 0.05 ampere in excess, in a 22 light three-wire 10 ampere meter. The error in the solenoids is corrected by allowances in the curvature of the pendant arch controlling the number of teeth picked up by the pawl on the ratchet wheel.

The meter requires to operate its pendulum about four-tenths (4-10) of a watt for a twenty-two light meter; 1,865 of these meters can be operated by one horse-power. Large sizes can be operated for a trifle more power. There is no increase of power required in proportion to the size of the meter because there is no brake and no increase of speed with larger loads.

In erecting the meter the only adjustment necessary is to see that the plumb bob hangs vertically. The meter is sent out calibrated. As all heavy bearings are roller bearings, there is no need of lubrication anywhere about the meter, so that an annual inspection is all that is necessary.

The American meter is the outcome of several years' continuous experimenting, and is built under the patents issued January 29, 1895, and March 10, 1896: and under patents allowed as follows: Serial No. 582,295, May 13, 1896; Serial No. 582,296, May 19, 1896; Serial No. 582,292, May 25, 1896, and Serial No. 582,293, July 2, 1896. Other patents have also been applied for.

SHIPMENT OF AMERICAN BALL ENGINES.

The American Engine Company, of Bound Brook, N. J., have begun the shipment of their new engine known to the trade as American-Ball Engines. The first of these engines of 100 horse-power capacity has gone to the Detroit "Evening News," and the second, a 50 horse-power engine, to the Savannah "News." Since the addition of this new line of work, the business of the American Engine Company has increased so that they are now compelled to run double time, having installed a night force. In the electrical department, among the recent shipments are the following: Cliff Paper Company, Niagara Falls, N. Y., 2 motors, 150 horse-power each; Detroit "Evening News," Detroit, Mich., 2 dyamos, each 25 kilowatt; "Albany Morning Express," Albany, N. Y., one 18 kilowatt dynamo; "Oakland Tribune," Oakland, Cal., 25 horse-power motor; A. N. Kellogg Newspaper Compnay, Chicago, Ill., four 15 horse-power and one 25 horse-power motors; "Topeka Capital," Topeka, Kas., 5 horse-power motor; "Boston Traveller," 12 horse-power and 5 horse-power motors; "Worcester Post," Worcester, Mass., 9 kilowatt dynamo; "Cincinnati Post," Cincinnati, O., 35 horse-power motor; "Philadelphia News," 25 horse-power and one 3 horse-power motors; "Elmira Gazette," 25 horse-power motor; American Newspaper Publishing Company, 25 horse-power motor; Carrington Publishing Company, 12 horse-power motor; J. B. Cranfill, Waco, Tex., 25 horse-power motor; Fall River Publishing Company, Fall River, Mass., one 25 horse-power and 3 horse-power motors; "Saginaw Evening News," Saginaw, Mich., 12 horse-power motor; B. A. Meade Company, Augusta, Me., 3 horse-power motor; "Chicago Journal," 15 horse-power motor; "Grand Rapids Democrat," 15 horse-power and 3 horse-power motors; "St. Paul Pioneer Press," St. Paul, Minn., 5

horse-power motor; Wallace Publishing Company, Des Moines, Ia., 12 horse-power motor; "New York Tribune," two 15 horse-power motors; Rubber Tire Wheel Company, New York, N. Y., 12 horse-power motor.

THE L. E. KNOTT X-RAY APPARATUS.

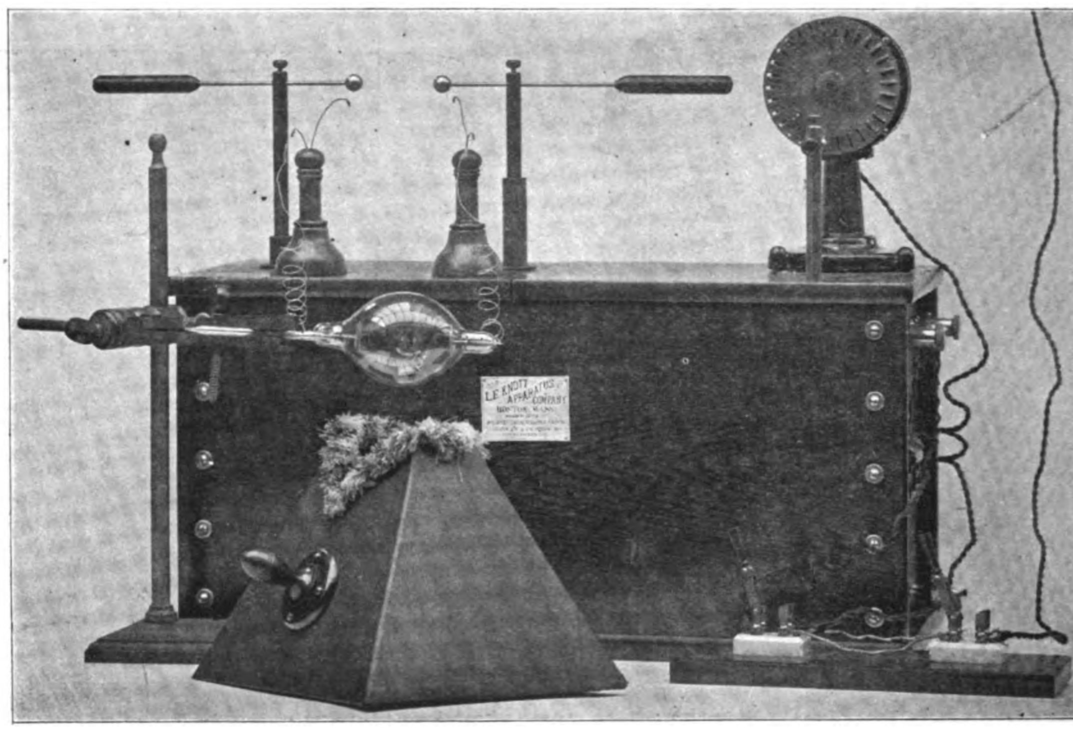
THE accompanying engraving represents the complete set of X-ray apparatus now being introduced by the L. E. Knott Apparatus Co., of Boston. The entire set of apparatus occupies no more space than the coil with condenser, and not so much as the static machine.

The arrangement represents the apparatus as now extensively used in many of the leading hospitals where an alternating current is available. In this apparatus the required voltage is obtained by a powerful step-up transformer, the secondary of which is used to charge a condenser, which in turn is discharged through the primary of the Tesla coil. The secondary of the Tesla terminates in the discharge poles shown in the cut, the transformer, condenser and Tesla coil all being contained in the case.

So far the instrument differs only in compactness from other high frequency coils which have been made. The uniform discharge of the condenser, however, is a point which heretofore has not been successfully obtained. The combined spark gap and air blast attached to the motor shaft renders this absolute and sure. To run this machine successfully requires only 4½ amperes at 52 volts, or 2¼ amperes at 104 volts.

By an easy adjustment of the binding posts on the outside of the case either 52 or 104 volts may be used without any external resistance. The operation of the apparatus is controlled by the two switches shown in the engraving. While the success of this instrument is unquestioned by those who have seen it in operation, many have been debarred from using it through not having an alternating current accessible. This difficulty, however, has recently been overcome by the devising of a successful interrupter with this latter device, which is mounted on the same motor which bears the spark gap discharger. The continuous current primary is interrupted 12,000 times per minute.

By an easy adjustment of the binding posts on the outside of stream of discharges is produced between the terminals; in this case, however, only in one direction. In the use of this instrument a single reflector tube is employed, the same as has been used in the induction coil or static machine.



THE L. E. KNOTT X-RAY APPARATUS, WITH TESLA COIL.

THE ALEXANDER-CHAMBERLAIN COMPANY have removed their offices to 56 West Twenty-second street, New York.

F. E. BAILEY & CO.

Messrs. F. E. Bailey & Company, of Philadelphia, have secured the contract with the Birdsboro Electric Light and Power Company, for the building of a complete electric light plant having a capacity of 1,000 lights.

The same firm, as representatives of the Armington & Sims Engine Company, have recently received orders for the following engines: One 150 horse-power engine, connected to line shaft, for the electric light plant owned by the borough of Quakertown, Pa.; one 500 horse-power engine to be directly connected to line shaft for the Nanticoke Electric Light, Heat and Power Company, Nanticoke, Pa. One 130 horse-power engine, direct connected to line shaft for the Birdsboro Light and Power Company, Birdsboro, Pa.; two 40 horse-power engines and one 140 horse-power engine for the Mansion House Electric Light Plant, Reading, Pa.

Most of these engines are of the new self-oiling type, with the improved governor, which are in great demand at the present time.

The Armington & Sims Works are running day and night of late in order to be able to deliver on time the large number of engines that they have orders for.

THE MICHIGAN MINING SCHOOL.

The Michigan Mining School has recently issued a catalogue which for thoroughness in point of detail will be found difficult to rival. It has been the aim of the compiler to answer every question put to the director regarding the school since its establishment in 1887. The book contains 285 pages descriptive of the different courses with cuts illustrative of the buildings. It also embodies much valuable data on the mineral resources of the State with maps showing the location of the various mines.

This School, situated as it is in the heart of the mining district, is one of the best equipped colleges of the middle West and offers the student every opportunity for practical experiment and observation.

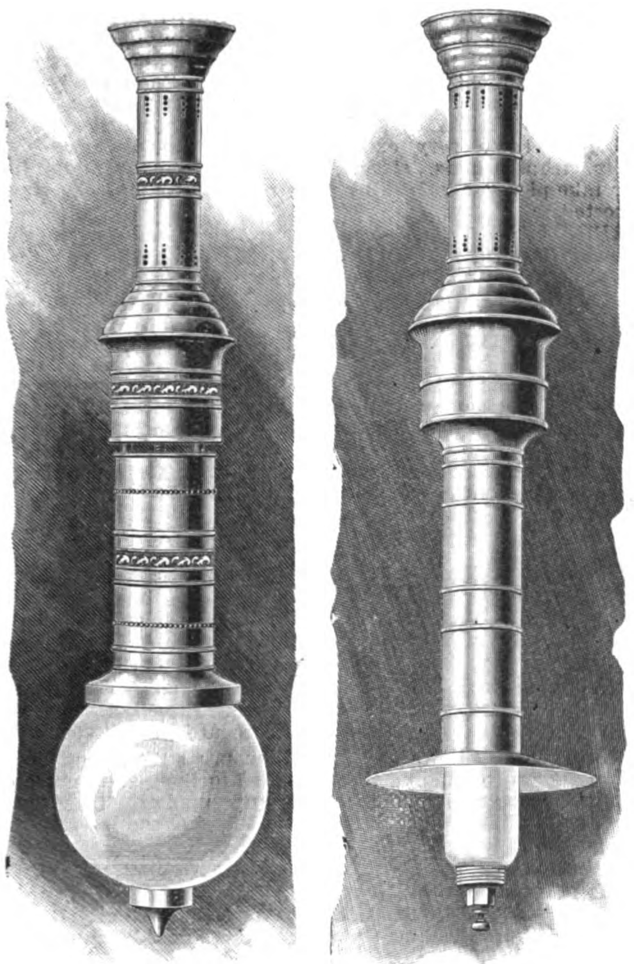
The electrical course was one of the first instituted, and the instruction is such as to afford an exact knowledge of the subject in its many applications to lighting and power work. The special object is to fit the student to be an engineer in the fullest sense of the term, rather than to have him devote all his time on applications whose details are constantly changing and which will not ultimately prove of advantage to him.

THE DIEHL CO.'S ENCLOSED ARC LAMP.

THE latest product of the works of the Diehl Manufacturing Company, of Elizabethport, N. J., is an enclosed arc lamp, the design of the company's well-known lamp expert, Mr. John Knight.

Besides the now well recognized features of the enclosed arc, the Knight lamp claims special attention on account of the method of clamping the globe, which does away with the cumbersome side castings or rods, and thereby eliminating the usual shadow. The construction is such that any ordinary straight lamp chimney, such as is commonly used with an argand burner, may be substituted in case of breaking, thus relieving the user of the necessity of keeping a supply of specially made globes.

The pair of solenoids are securely fastened top and bottom, which gives the mechanical construction strength and simplicity, and the clutch consists of a tilting washer. Our illustration, Fig. 1, shows the new lamp complete, while Fig. 2 shows the lamp with inner globe and reflector. This is adapted for lighting storehouses and large areas, and takes only three amperes.



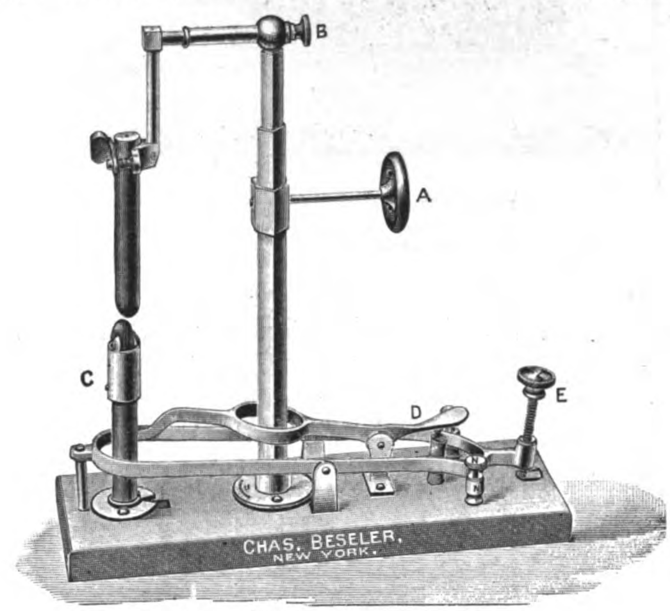
THE DIEHL CO.'S ENCLOSED ARC LAMP.

The Diehl Company also manufactures a regular series arc lamp. These lamps have an auxiliary striking magnet which prevents the chattering of the carbons and insures the striking of the full arc immediately the lamp is switched in circuit. These lamps are built for circuits of from 4 to 10 amperes, with a pressure of 45 volts, and can be connected two in series across 115 volt and 4 in series across 230-volt circuits. These lamps are built in a variety of styles for interior and street use.

The Diehl Company have added extensive machinery to their already large equipment for the purpose of manufacturing the lamps above described.

THE BESELER ELECTRIC LAMPS AND LANTERNS.

ONE of the most widely known patentees and manufacturers of high grade stereopticons and magic lanterns adapted for electric light, lime or oil light, etc., is Mr. Charles Beseler. His extensive works occupy almost the entire building 218 Centre street, New York, and give employment to a large force of men engaged in turning out stereopticons with arc lamps, for which there is a constant and growing demand. One of his best sellers is the "Bijou" electric arc lamp with hand feed arrangement, as shown in the accompanying cut. The lamp may be used in conjunction with any good magic lantern using either the direct or alternating current. It is of the latest and most improved type, and possibly the only hand-feed lamp that will enable the operator to produce a most brilliant and uniform disc on a screen without flickering. The lower carbon is automatically kept at a given point and only the upper carbon requires feeding by turning the wooden knob at A. B is a patent device for adjusting the upper carbon in order to produce a clear and uniform disc on the screen. No electric lamp can be of much service in lantern work without this important feature.



BESELER BIJOU HAND FEED ARC LAMP.

C is a detachable hood, provided with bayonet catch, so as to admit lower carbon of five inches in length. D is the lever for controlling and feeding the lower carbon automatically; E, the screw for raising or lowering the entire lamp about one inch, in order to reach the centre of the condensing lens accurately. Further details of this lamp, as well as all other specialties, can be got from the manufacturer, whose stereopticon and magic lanterns are used in the electric line for projection purposes as well as in many others, notably in schools and colleges for illustrating purposes. Beginning with the year 1895, Mr. Charles Beseler has been awarded the contract for furnishing his stereopticons and magic lanterns to the city and village schools of the State of New York. The one used by Prof. Albert S. Bickmore, of the American Museum of Natural History, New York City, is of Mr. Beseler's make.

REDUCTION IN PRICE OF BRASS ARMORED INTERIOR CONDUIT.

As will be seen in our columns elsewhere, the Interior Conduit and Insulation Company, of New York City, announce a reduction in the prices of their well known brass armored insulating conduit, elbows and couplings. The enormous sales of this material during the past year have reduced the cost of production; hence the reduction in price.

This company will shortly place upon the market a new and improved iron armored conduit, full particulars of which will soon be given.

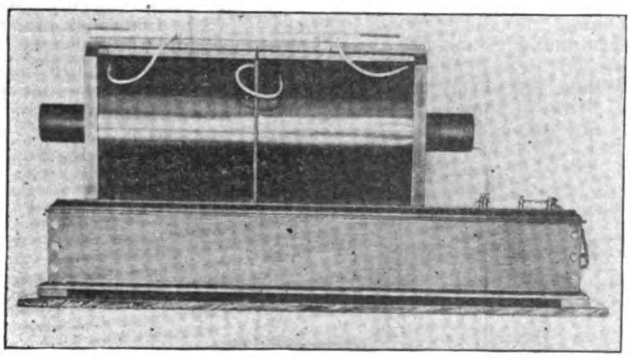
RICHMOND, VA. The Chamber of Commerce has come out in favor of the new anti-Bell telephone service furnished by the new Richmond Telephone Company.

THE ERIE TELEGRAPH AND TELEPHONE COMPANY has declared a regular quarterly dividend of 1 per cent. The earnings are a little ahead of 1895, and so is the net surplus.

THE INTERNATIONAL RUHMKORFF COILS.

THE International Electric Company, of New York, have built up an extensive business in the manufacture of Ruhmkorff induction coils, making a specialty of large coils for colleges and schools.

Among their shipments this week is one unusually large coil, shown in the accompanying illustration, Fig. 1, made for a Western college, and which deserves comment. This coil



12" SPARK RUHMKORFF COIL BUILT BY INTERNATIONAL ELECTRIC CO.

measures 21 in. long and 11 in. in diameter, mounted on a mahogany base 31 in. x 17 in. x 5½, weighing complete about 75 pounds. It is wound in two multiple sections, each containing three smaller ones. The primary wire consists of 246 turns of No. 6 double covered magnet wire. An excellent spark of over 12 in. in length is given by this coil.

A separate vibrator, shown in Fig. 2, is to be furnished with the coil, making it possible to remove both the primary wire and secondary sections.

The vibrator contains a switch and current reverser, and

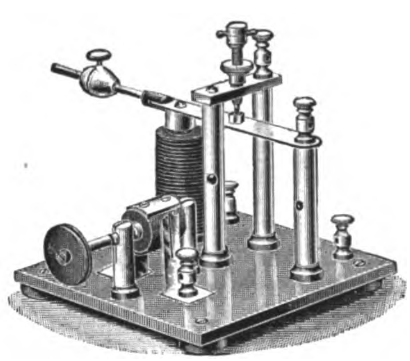


FIG. 2. VIBRATOR FOR RUHMKORFF COIL.

can be regulated to vibrate fast or slow. The platinum points are riveted on and of good proportions. All brass parts are finely lacquered. Twelve volts and 18 amperes are required to operate the coils.

WALKER APPARATUS IN GERMANY.

The Electricitäts-Gesellschaft, Felix Singer & Co., of Berlin, Germany, inform us that they have secured the contract for installing the Walker apparatus on the Upper-Silesian steam railway, which passes through the whole industrial district of Upper-Silesia, this road having determined to transform its traction from steam locomotives to electricity.

The electric system will be introduced at first on the lines (1) Gleiwitz, Zabrze, Koenigshuette, Beuthen, Deutsche Piekar and (2) Koenigshuette, Kattowitz, Laurahuette, Koenigshuette, for which thirty motor cars and a corresponding number of trailers are provided. Freight traffic will also be introduced on the above-named lines.

The cars are mounted on two swivel trucks of 785 mm. gauge. Each of the four axles will be driven by a 20 horse-power motor. The company have the order for the electric installation of these cars, consisting of 120 motors and the whole electrical outfit, including controllers, safety devices, lighting, etc.

The gauge is quite a small one for an electric street railway car having motors mounted in the usual way. This narrow gauge was caused by local conditions. The company, assisted by the Walker Company, whose representatives they are, have overcome these difficulties by devising a new special type of motor for this gauge. The length of both lines is about twenty miles.

ADVERTISERS' HINTS.

THE ELECTRIC ARC LIGHT COMPANY says the "Pioneer" is the best substitute for day light, and not only that, but its quality and cheapness are unparalleled.

THE MICA INSULATOR COMPANY are always ready to supply everything in the way of mica and micanite specialties.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY state that the number of their lamps in use has increased to 10,000 and it has by no means reached its limit.

WM. TAYLOR, 203 Broadway, New York, advertises a twentieth century 150 hour enclosed arc lamp for $19.50 and will forward one on thirty days' trial to prospective buyers.

THE BERLIN IRON BRIDGE COMPANY illustrate an iron truss roof built by them for the Burlington City Water Works, at Burlington, Vt. It is designed to carry a track through the trusses so that coal may be distributed from a car.

THE INTERIOR CONDUIT AND INSULATION COMPANY advertise brass armored conduits, couplings, elbows, etc. By reason of their large sales during the past year they have been enabled to reduce the price on these goods and they will be pleased to mail the new list on application.

THE ELECTRICAL EXCHANGE, Monadnock Block, Chicago, offer some very excellent bargains in dynamos and motors, transformers, street hoods and electrical supplies. They take pleasure in mailing their monthly bulletins to those interested.

PREST. KEELYN, of the Western Telephone Construction Company, informs us that Mr. W. A. Bisland has been elected vice-president of the company in place of Mr. G. F. Stitch, and that the latter is no longer in the service of the company.

MESSRS. WILLIAMS, COUCH & WHITMAN are now located at 196 Summer street, Boston. This change in their quarters was made imperative by the need of greater facilities for the transaction of their increased business. They are the sole selling agents for the United States of the Ericsson Swedish microphone. These goods are standard abroad and, owing to their high quality and durability, their popularity grows each day wherever used.

NEW YORK NOTES.

WENDELL & McDUFFIE, 26 Cortlandt street, New York, sell snow plows, sprinklers, transfer tables, wheels, brake shoes, metallic packing, railroad supplies, etc., and have worked up a large trade in their specialties.

THE CLIMAX GAS ENGINE WORKS, with regard to whose engine an article appeared in these pages last week, has its headquarters at 31 Fulton street, Brooklyn, where it will be glad to answer all inquiries in regard to that specialty.

WALCUTT & LEEDS, 53 East Eleventh street, New York, occupy the entire building there devoted to the manufacture of phonograph or graphophone records and supplies. They manufacture also the blank cylinders and sell also the latest types of the Edison phonograph.

STERLING SUPPLY AND MANUFACTURING COMPANY, 97 Bank street, New York, import and cut to order large quantities of rattan to be used for car sweepers. Recent orders filled for these goods were to the Third Avenue Railroad Company, New York, and to J. G. Brill & Co., Philadelphia. Their registers and brakes are now finding a large market in Australia.

POOR'S MANUAL.—The twenty-ninth annual number of Poor's 1896 Manual of the Railroads of the United States has appeared corrected to August 22,1896. It contains names of all steam railroads, street railway and traction companies, industrial corporations, national, state and municipal finances. It is published by H. V. & H. W. Poor, 44 Broad street (Edison Building), New York.

MR. THOMAS J. FAY has opened an office in the Central Building, No. 143 Liberty street, New York, where he will conduct an electrical engineering business. Mr. Fay will also act as a representative of the Crocker-Wheeler Electric Company in New York and vicinity, in addition to which he has secured control of the sole agency for the Crocker-Wheeler dynamos and motors in Mexico, Central America, South America and the West Indies. Mr. Fay is in position to take hold of any business intrusted to his care, and invites his friends at his new quarters.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. NOVEMBER 18, 1896. No. 446.

Electric Transportation.

THE JUNGFRAU MOUNTAIN ELECTRIC RAILWAY, SWITZERLAND.

In this century of bold engineering one has ceased to be startled at the announcement of stupendous undertakings, but one must confess to a feeling of awe at the contemplation of a work just recently begun, which has for its object nothing less than the building of an electric railroad to the very top of the Jungfrau Peak, in Switzerland. This project, which has been on the tapis for some time, has now been fully organized under the able management of M. Guyer-Zeller, of Zurich, who has received all the necessary concessions from the Swiss Government, and whose faith in the scheme is such that he has himself invested a large part of his private fortune in the enterprise.

In order to realize the extent of the undertaking, we need only say that the Jungfrau Peak is 4,166 meters (13,670 feet) above sea level. Although heights approximating these have been attained in some of the railroads in the Andes, and in the mountainous districts of our own Western States, no such grades as will here be employed have been attempted, and a vivid idea of what the undertaking involves may be gathered from the fact that from the lower terminal at Scheidegg to the Jungfrau Peak, the difference in level is 7,000 feet, which rise will be accomplished in the total length of the road of only 7½ miles. But in addition to the mere engineering features of the road, which are of themselves of great interest, other questions have arisen in connection with the building of this road of no less importance, such as the influence upon passengers of the rapid transportation to such heights as the Jungfrau Peak, as well as a number of aesthetic points, involving the location of the road, so as to avoid detracting from the natural beauty of the landscape.

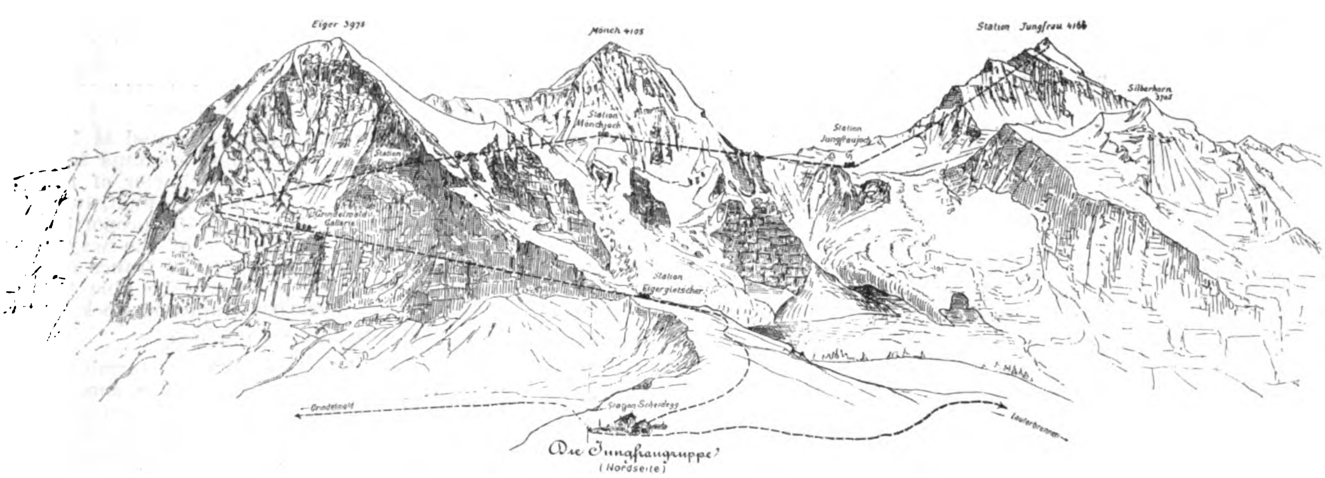
THE ROUTE.

The route chosen for the road takes account both of the difficulties of the ground and the requirements of the tourists, which it will be necessary to satisfy. Starting from the Scheidegg station, as indicated in the accompanying map, and shown in the view below, the road runs above ground along the rocky wall of the Eiger Mountain to the edge of the Eiger glacier, where the Eiger glacier station is located. From there the road enters a tunnel and follows towards the east, rising with a grade of 25 per cent., which is continued to the neighborhood of the great Bernese wall, north of the Eiger, several yards back from the surface of the wall, so as to allow, if desired, the making of an opening, in order to establish an arcade station within the wall, which station will be called the Grindelwaldblick (Grindelwald View).

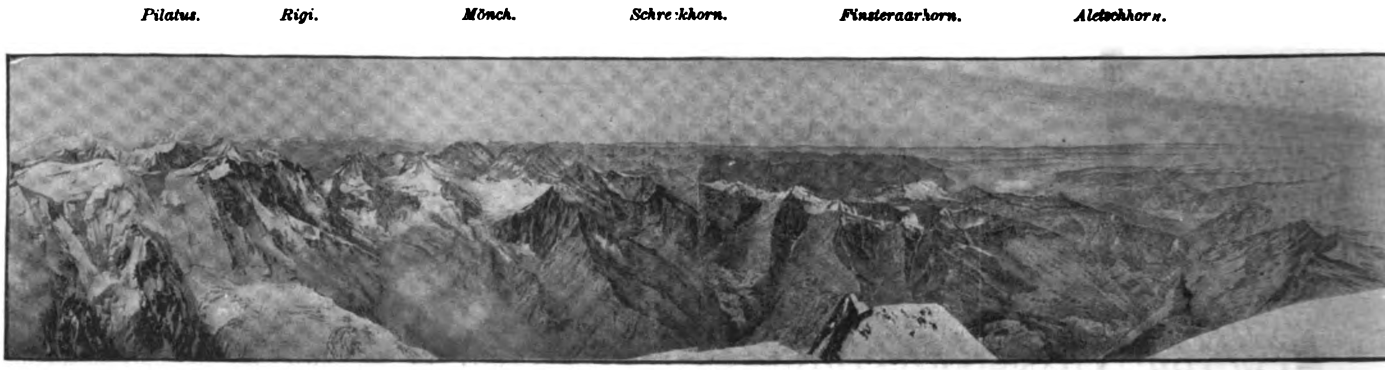
The road then continues along the same wall, below the Mittelegi Glacier; there the tunnel takes a large curve, passing through the calcareous layer which forms the Eiger, and passes to the other side southeast of this mountain. The tunnel again follows along the wall, keeping within a few yards of the side, and then it takes the direction from northeast to southwest, toward the Jungfrau.

Under the brow of the Eiger, opposite the superb Vieschwand, a station will be erected, called the Eiger Gallery, a view from which will extend over the entire chain of the Schreckhorn mountains. From this point the line stretches towards the Mönch mountain, following the northwest wall, and, from a vertical, passing under the summit, the line takes the direction towards the Ober Mönchjoch to the rock platform station, called Mönch. This will undoubtedly be one of the most popular stations for tourists, owing to its superb situation. It is in the center of a circle of magnificent glaciers. At the right is situated the Jungfrau Firn, and its magnificent crevasses; at the left is the vast and tranquil Ewigschneefeld (Everlasting Snow Field), almost without crevasses, where even the most inexperienced tourist can, without danger or difficulty, walk and admire at his ease the frozen altitudes of eternal snows, still unknown to the greater part of those who frequent the Alps, and which have been heretofore neglected, owing to the lack of efficient means to observe them from above.

From the Mönch the line continues along a descending grade, passing to the Jungfrau Mountain itself. At that point a double opening permits the tourist to see the two sides of the mountain chain. At one side, towards the south, he will be able to see in its greatest majesty the formidable Aletsch, the greatest glacier in the Alps. From the south side the eye will plunge into the abyss of the Grindelwald, which will be at the tourist's feet, 4,650 feet below. The line ascends to just beneath the summit of the Jungfrau. An



View of Jungfrau Electric Railway, Showing Location of Stations.



THE "TROLLEY TO HEAVEN." VIEW OF THE EVERLASTING SNOW AND GLACIERS AS SEEN FROM THE JUNGFRAU PEAK, SWITZERLAND.

elevator, with a lift of 330 feet, will then carry passengers to daylight, to the peak itself.

In this way, the Jungfrau line represents a little more than twelve kilometers (7½ miles) of road, ten of which are in tunnel with openings at frequent intervals, the changing views from which will be an incessant delight to the tourist.

METHOD OF CONSTRUCTION AND OPERATION.

As regards the method of construction to be adopted, the successful operation in Switzerland of forty mountain roads employing the rack rail, has decided the adoption of the same type for the Jungfrau road, and the success of the recent electric roads, such as the Salève, and others, with their marked advantages over steam, determined, without question, the adoption of electricity as the motive power.

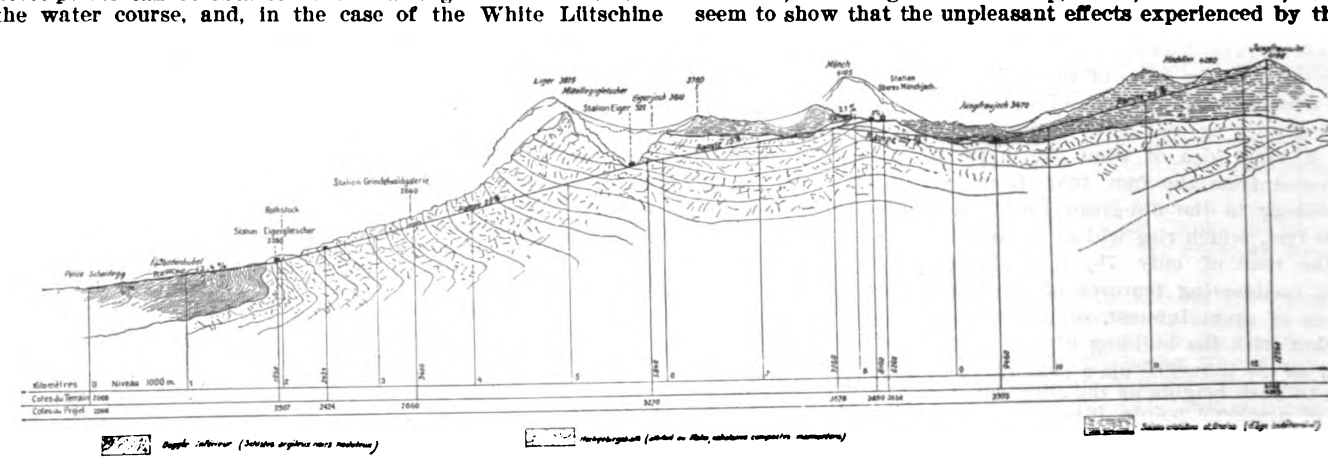
The substitution of electricity for steam is especially advantageous in the case of the Jungfrau road, as regards both the source of power, the boring of the tunnel, and the lighting and heating of the cars. The particular advantage of electricity over steam may be cited as follows: 1, More advantageous ratio of useful load to dead load; 2, more regular, and smokeless operation of the cars; 3, safer meshing of the gear teeth, in consequence of the rotary transmission of the tractive power to the wheels of the vehicle; 4, decreased expense for maintenance and attendance of the cars; 5, saving in cost of operation.

Experience on Swiss mountain roads has led to the adoption in the present case of a one-meter gauge of track, and a minimum curve of 100 metres has been adopted. A maximum grade of 25 per cent. has been adopted, and down-grades will be avoided as much as possible. The heaviest down grade, 10 per cent. will only occur between the Mönchjoch and the Jungfraujoch.

The maximum speed on grades above 15 per cent. will be 8 kilometers—5 miles per hour—and on lesser grades 8½ kilometers.

THE ELECTRICAL WORK.

Power for operating the road will be derived from the waters of the Black and White Lütschine, in Burglauenen and Lauterbrunnen. In the case of the Black Lütschine, 3,000 horse-power can be obtained within a length of 750 meters of the water course, and, in the case of the White Lütschine



PROFILE AND GEOLOGICAL SECTION OF JUNGFRAU ELECTRIC RAILWAY.

1,500 horse-power, within a length of about 700 meters, can be obtained. Assuming as a maximum traffic the simultaneous operation of three trains ascending the road and three trains descending, with two hundred passengers in each direction, or a total of four hundred passengers, a central station of 1,400 horse-power capacity will suffice to operate the road. This power, as estimated, will be divided as follows:

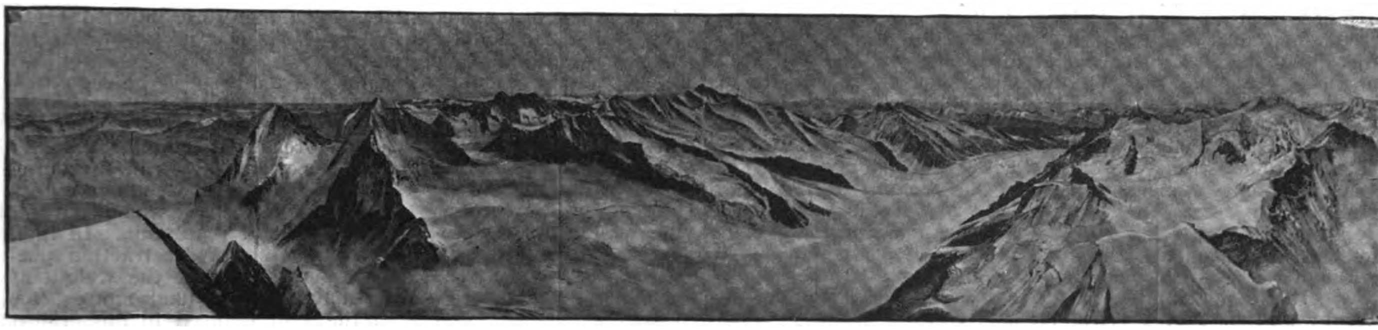
	Horse-power.
1. Current from secondary circuits on the line of the road to the cars	667
2. Illumination of the tunnel	50
3. Illumination of six cars	8
4. Station illumination and elevator	200
5. Heating of six cars, when the outside temperature is 3 deg. C. below zero, and the interior of the cars 17 deg. C., an allowance of 20 horse-power must be made for each car running at 8 kilometers per hour	120
Total power to be delivered by secondary circuit	1,046
6. Counting 10 per cent. loss in the secondary circuit, 6 per cent. in the transformers and 10 per cent. in the primaries, the station will have to be built for	1,325
7. Power required to be given gratis to the corporation of Lauterbrunnen	50
Grand total	1,375

COST OF CONSTRUCTION.

The total cost of this undertaking is estimated at 10,000,000 francs ($2,000,000), which, with elevator, amounts to 780,000 francs per kilometer. According to the charter of the road, the fare from the valley to the top of the Jungfrau and return may not exceed 45 francs ($9), with proportional reductions for passengers going only part of the way. After allowing for 4 per cent. interest on 6,000,000 francs of bonds, the projectors estimate that the road will be able to pay a 6 8-10 per cent. dividend on 4,000,000 francs of stock.

HYGIENIC CONDITIONS.

As the great height reached by the upper terminal of the road is in a region of low barometric pressure, some concern was felt as regards the health of passengers transported to the highest peak. The reports of experts on this subject, however, including that of E. Spelterini, the æronaut, would seem to show that the unpleasant effects experienced by those climbing to great heights are due largely to the reduced vitality of the body, caused by the previous exertions undergone during the ascent; but, as in the case of balloon ascents,

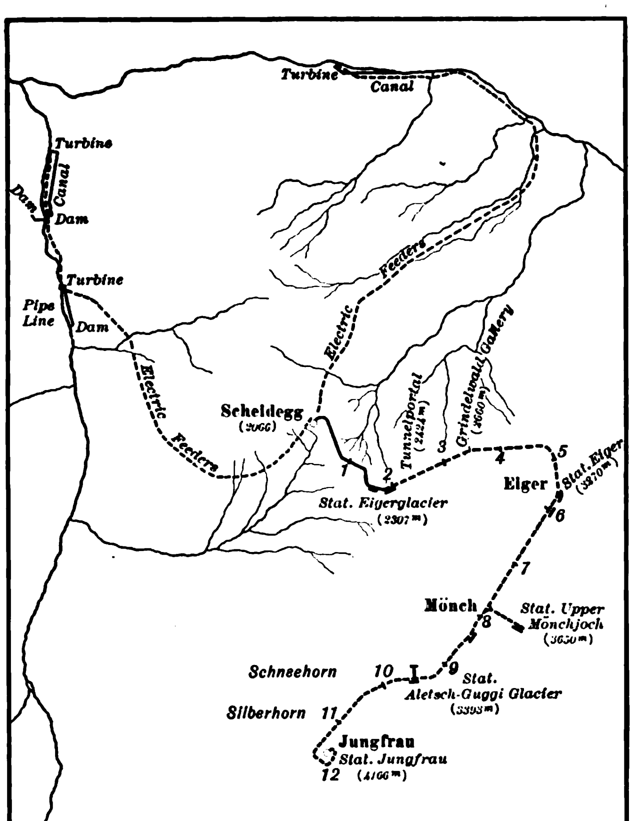


TO BE REACHED BY ELECTRIC ROAD AND ELECTRIC ELEVATOR.—14,000 FEET ABOVE SEA LEVEL.

where no bodily exertion is required, there need be no apprehension on this score.

As cited above, the cars will be heated electrically. This becomes necessary, owing to the fact that the average temperature in the tunnels, it is estimated, will be between 2 and 6 deg. C. below zero up to the Mönch station, and between 6 to 10 deg. C. below zero from that point to the Jungfrau station.

The great difference in temperature of the air at the opposite ends of the tunnel, it is believed, will be ample to set up a circulation of air sufficient for ventilating the tunnel. In fact, it is feared that the currents will be so strong that it



MAP SHOWING ROUTE OF JUNGFRAU ELECTRIC RAILWAY.

may be necessary to close the portals, in order to control them properly, and to avoid the entrance of warm, moist air from below, which will cause the deposit of moisture on the inside of the tunnel, and coat them with hoar frost. At the speed given, it will require one hour and forty minutes' continuous ride to go from the lower to the upper terminal of the road.

It is expected that the first section of the road will be ready for traffic by next August, while the entire road will be completed in five years, each section to be opened as soon as ready.

THE WAUKESHA (WIS.) ELECTRIC COMPANY is to put in a large plant for power purposes.

THE INSTITUTE DISCUSSION ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.—I.[1]

BY DR. CHAS. E. EMERY.

IN the light of recent achievements, it can be assumed at the outset that electric traction under steam railway conditions is feasible. The only question is whether it will pay. The present applications only prove the former proposition, but do not touch the latter.

It does not seem probable, under present conditions, that any probable increase of travel will warrant the enormous outlay necessary to secure electric traction throughout the whole length of our trunk railroads.

The greatest practical efficiency of an electric system of the kind proposed between the engines at the central station and the rails, would probably be 60 per cent. This, on account of a second transmission to sub-stations and the necessity of using rheostatic regulation to some extent, would probably be reduced to 50 per cent., so that twice as many horse-power would need to be generated at the central station as at the track with the present steam locomotives. Each horse-power in the central station will be developed for two pounds of cheap coal or four pounds per net horse-power delivered, whereas the steam passenger locomotive will on the average require six pounds, based on net tractive force and allowing for the various wastes. The saving in coal due to electric passenger traction will therefore be one-third. Coal is procured cheaply by the railroads, but probably an inferior quality, costing 50 cents per ton, or, say, 25 per cent. less than that used on locomotives, could be employed in the electric stations, so that, for trains of like weight, the saving in cost of coal for passenger service would be $\frac{3}{4} \times \frac{2}{3} = \frac{1}{2}$. For freight engines we calculate the saving in cost for fuel will be about 55 per cent., and for switching engines about $66\frac{2}{3}$ per cent. On railroads running through the coal regions the total cost of coal is about 9 per cent. of the total operating expenses. A saving of one-half in the cost of the coal then corresponds to a saving of 5 per cent. of operating expenses. For reasons that will be stated later, it is believed that, for general railroad work, independent electric locomotives will be required, and that these will necessarily be as heavy as present steam locomotives, on which basis the only saving in weight will be that of the tender, which we have assumed as 10 per cent. of the total weight of the train for passenger engines, 3.3 per cent. for freight engines, and 5 per cent. for switching engines. The total load to be hauled will therefore be decreased by these several percentages, and the cost of coal reduced thereby to 45 per cent. of that required by the present locomotives for passenger trains; $43\frac{1}{2}$ per cent. for freight trains, and 32 per cent. for switching trains. Applying these percentages for the relative amounts of coal used for these different purposes on a prominent railroad, the average saving in fuel becomes 58.9 per cent., or 5.89 per cent. of operating expenses. The cost of water is taken at $\frac{2}{3}$ of 1 per cent., on the same basis which increases the saving to 6.56 per cent.

Considerable saving has been claimed on other grounds. First, in relative repairs of electric motors compared with locomotives. Repairs will be less on the motors, of course, but are not inconsiderable, and when we consider that the transmission line, trolley line and trolleys must be kept in repair as well as the motors, it cannot be far in error to assume that

[1] A topical discussion at the 109th meeting of the American Institute of Electrical Engineers, New York, Oct. 21, and Chicago, Oct. 28, 1896.

the question of repairs will be about balanced, independent of central station apparatus otherwise provided for.

It has been claimed that labor will be saved, because the second man on an electric locomotive is required simply to provide for sickness or accident of the driver, and can well be the baggageman of a passenger train or the conductor of a freight train. Something of this kind may be worked out on an unimportant country road, but it would be impracticable on a large business scale. If a trunk line were to be changed to electricity to-morrow, the best policy would be to keep the old engineers to operate the locomotives and learn of electricity as fast as possible, and to put the young men from the training schools of the large companies as the second men to watch electrical details and overcome unforeseen contingencies, the firemen taking their places as they learn how. It is also claimed that there will be a saving in the weight and cost of electric locomotives, particularly when applied under a car, but this system is of limited application. Heavy locomotives on trunk lines must have the same weight for electric as for steam traction, independent of the tender, as explained hereafter. Large savings in repairs to tracks and bridges are also claimed on account of the smoothness with which electric locomotives, having no reciprocating parts, would operate. The same weights must be run over the same rails at the same speed, and at least a great part of the wear and tear would be due to inequalities of the track surface, which would influence both systems alike. The present locomotives are so designed that, while the wheel loads on the drivers are heavy, the masses which strike blows are comparatively light; that is, they have simple wheels and axles, spring-connected to the frames. This is a very difficult thing to accomplish with an electric locomotive without using exactly the same construction. On a comparatively smooth track, remarkable steadiness of movement may be obtained, if the armatures of the motors are secured to the axles of the driving wheel and the fields supported concentric therewith, but such an arrangement is entirely unfitted for a railroad track in average condition. Springs only relieve the frame. Each pair of wheels and attached motor acts as an enormous trip-hammer on the rails and roadbed the moment the former gets the least out of alignment, by defect in original construction, by settling after rains or from other causes. A connection to driving axles through gearing reduces the blows very materially, but introduces at high speed another difficulty. The vertical movements of the main axle would necessarily cause a change in the angular velocity of the armature during the time of such movement, which, for jars occurring in the fraction of a second, would bring a heavy strain on the gearing and vary the speed of the armature momentarily. The variations in current due to such variation may also give a longtitudinal pulsation to the train. The matter is not helped at all by mounting the motors on hollow axles concentric with the driving axles, so that the motors may be spring-supported from the axles, for in such case the connection of the motor to the axles must be through links the equivalent of a universal joint, which produce variations in velocity, when the axles are out of centre with the armature, similar to those where gearing is employed. In fact, these very devices are used to obtain variation in angular velocity in many machines. Either gearing or universal joints would have back lash when current was shut off. The suggestion recently occurred to the speaker, and he has not had time to calculate the effect of these considerations, but they must be serious. A train at 60 miles an hour moves about 90 feet a second, sufficient to cover a number of yielding rail joints in that time. When the New York Central Railroad started its fast trains, the engineer found it necessary to go over the alignment with instruments; as dips and vertical curves, which would not be noticed by the trackmen, gave very unpleasant motions to the cars at high speed.

For reasons above given, it will be necessary to mount electric motors for fast locomotives away from the centres of the axles and connect through side rods, as in the present locomotives. The only other method would be to use chains, which are mechanically impracticable. There is another important reason for this. In order to obtain speed, the motors must be wound for it so that the counter-electromotive-force will be produced by velocity rather than the number of turns, and, in starting, the motors are necessarily connected in series so as to reduce the starting current. For motors adapted to very high speeds, it will be necessary to put pairs in series even to surmount heavy grades, to act as pushers in case of accident, or in removing snow, etc. The counter-electromotive-force is therefore divided between several motors, but not necessarily in equal degree. If, with motors connected to separate axles, one for any reason slips its wheels, it will monopolize the larger portion of the electromotive force and cut down the current on all the motors in series, so that full power cannot be obtained. Working the motors in parallel with an enormous rheostat would be wasteful, and, in some cases, impracticable. It is, therefore, important for two reasons to connect driving wheels operated by separate motors by means of side rods.

Again, it is essential that, on the road, speed be regulated by better means than a rheostat. A series motor varies its speed with the load and so cannot run without rheostatic regulation at a given speed if for any reason the number of cars in the train or the track resistance varies. It will, therefore, be necessary to return to commuted series field coils or equivalents, and it will be perhaps desirable to have a shunt winding which can be used to give still closer regulation. In fact, shunt motors are being introduced abroad for traction purposes. The use of these devices will increase the weight of the motors compared with simple series wound motors, for the simple reason that with the field reduced to the utmost it must still be sufficient to prevent sparking, and there must be sufficient iron employed to make the stronger field efficient when it is desirable to run slower. These considerations make more room desirable for the motors than can be provided in the trucks of an ordinary car.

For these several reasons it is predicted that the high speed electric locomotive of the future will, like the steam locomotive, be a structure independent of the train, that the motors will be hung on the frame independent of the driving wheels, and the same as well as the driving wheels connected by side rods. To obtain proper room under such conditions larger driving wheels will be employed than the wheels of an ordinary car. This will so extend the wheel base that it will not be safe to run at high speeds without the leading truck, the same as on an ordinary locomotive, and, in fact, the electric locomotive will in all its general features be a steam locomotive without the boiler, with motors substituted for the steam cylinders. In this way and probably in no other can the flexibility of the present steam locomotive be obtained. Probably there will be greater difference of opinion on this subject than on any other. The use of motors in the trucks of baggage cars is so fascinating that strong efforts will be and should be made to retain such a system, though the reasons stated are believed to be sufficient to prevent its general adoption. Again, it is desirable that the whole locomotive be a unit, on a strong frame, calculated to resist the shocks due to collisions and accidents, and it is doubtful if locomotive drivers will be found who will be willing to risk their lives on any other kind of a structure.

To realize the flexibility of the ordinary locomotive one has but to go on the line of one of the roads which has not yet adopted the heaviest type of rail, but yet runs express trains at 45 miles per hour, grasp a convenient post close to the line and a little around a curve, if possible, where one can take the wind of the train, and watch its approach. In many cases the locomotive sways nearly a foot from the perpendicular, first one way and then the other. At a bad joint the plunge is so rapid that the effect can be described as terrific, as one cannot but think of the consequences if such a mass should leave the rails. The locomotive, however, follows the inequalities as readily as would a farm wagon. Electrical engineers may insist upon a more rigid and better track, but this will require additional expense and will not entirely overcome the difficulty. The electric locomotive must be constructed so that it will do the work of the present locomotive in the same way, and the feature of flexibilty cannot be sacrificed.

A modern heavy locomotive costs about $10,000, which is at the rate of $10 to $12 per horse-power, on about the same basis as electric motors would be rated. It needs little argument to show that an electric locomotive, to take its place under conditions stated, would cost fully as much. Moreover, if like care is to be taken of electric locomotives as of those for steam, the same number must be employed of like capacity for like work.

An approximate calculation of the cost of electrically equipping and operating a trunk line has been based on information in regard to the operating expenses of different railroads, given in the series of articles by Mr. Baxter, in The Electrical Engineer early this year. We have the highest respect for the industry and ingenuity of Mr. Baxter, as he was one of those who rendered valuable assistance to the speaker in carrying out a large enterprise a number of years ago, and we have adopted his facts, and for convenience have used some of his methods, but have been obliged to entirely disagree with his conclusions. For instance, we calculate that the cost of the steam and electric generating plants will be about three times as much as he states, the transmission plant and sub-stations about twice as much, and the operating expenses about 5½ times as much as he provides for. Necessarily the conclusions are diametrically opposite.

The calculations are based on the operating expenses of a railway system, comprising nearly 2,700 miles of road and employing 1,800 locomotives. By calculations based on the train miles, checked by the reported coal burned, and the probable number of engines in use, Mr. Baxter ingeniously determines an average of 140,000 horse-power, considered as continuously operated, which, in our calculations, we estimate will require to replace it 280,000 horse-power in the stations, on the basis of 50 per cent. efficiency from stationary engine pistons to track, and if 60 per cent. can be obtained by commutated fields, or other means herein discussed, the difference simply provides for an expected increase of travel. From the probable average power and the actual reported operating expenses corresponding thereto, we proceed as follows: For facility of calculation and to obtain an underestimate, rather than one too large, the power required for the switching engines is distributed among the regular trains on the road. It is also assumed that the average number of trains is continued the entire length of the road, instead of using a much greater number than the average for suburban travel. These methods cause an underestimate of the cost of the electric transmission, but enable the cost of operation to be accurately worked up from the averages. The latter is the more important point, as the other merely involves comparatively small questions of difference in the amount of interest. By this generalization the trains will be assumed as separated about 7½ miles, independent of direction, over the whole length of the road for every hour in the year. On this basis there will be required on the average 106 station horse-power per mile of road, independent of direction of trains, but to provide for concentrations which will inevitably occur, the generating plants and transmission lines have been worked out on the basis of 150 horse-power per mile. The assumed number of trains will require on the average about 400 horse-power each at track, or 800 at station, which is high for an average, as the power of the switching engines is, as explained, distributed along the whole line for convenience of calculation on the basis of averages. To obtain the economy due to fairly large stations they are assumed to be separated 45 miles from each other, and at two intermediate points transformers and rotary converters (transformers) located, by which means the feeders are supplied every 15 miles. On the above basis it is assumed that 6,750 horse-power is installed at each steam station, and 2,250 horse-power at each sub-station. To avoid overestimates the cost per horse-power of steam and electric plant in main stations has been assumed as only $80 per horse-power with $20,000 for buildings, and for the whole apparatus in the sub-stations there has been allowed only $10 per horse-power and $10,200 for buildings and the copper in the high tension lines. The low tension copper has been worked out on the basis that half-way between the main and sub-station two trains may meet, each requiring 1,000 horse-power, and that a uniform section of copper sufficient to carry 7½ miles, the current required for half of this power, at an original tension of 700 volts and a drop of 20 per cent., would be ample for the whole length of the low tension lines. On this basis the cost for copper at 13 cents per pound for the outgoing low tension conductors will be $12,386 per mile. It is assumed that provision for supporting the outgoing conductors and the bonds in main track for return current will cost $5,000 per mile. On the basis of these prices, without considering incidentals, the total cost of the electrical generating and transmission plant foots up $31,057 per mile, the annual interest on which, at 5 per cent., is $1,553 per mile. If the services of the 1,800 steam locomotives can be furnished by 1,500 new electric locomotives at $10,000 each, the same will cost $5,556 per mile, requiring $278 annual interest per mile, making the total interest on steam and electrical plants, including locomotives $1,831 per mile. The operating expenses of the station considered as a steam station only, from Emery's tables reduced to 24 hours and 365 days, modifying cost of plant and eliminating coal and interest, is found to be $25.84 per average horse-power per year. The time of 12 extra men for care of electric apparatus in the main and two sub-stations amounts to $2.75 per horse-power per year, which makes the total operating expenses of the generating, transmission and locomotive plants, exclusive of coal and interest, $28.59 per average main station horse-power per year, or $3,031 per mile. or, with interest added, viz., $1,831, as above, a total of $4,862 per mile. The operating expenses of the station thus calculated include an allowance for repairs, insurance, taxes and renewals. It should be recollected that the cost of coal has been already provided for in the percentage of saving first developed, and that the train expenses are assumed to be the same as for steam locomotives. The operating expenses of the road using steam, amounted to $15,187 per mile. Of this, as previously stated, 6.56 per cent. will be saved by the use of electricity, corresponding to $996 per mile. This, substracted from $4,862 per mile (given as the cost of operating expenses of the generating stations, etc., with interest added), leaves $3,866 per mile per year as the additional expense which will be entailed by the application of electricity as a substitute for steam; so, on the basis that the operating expenses are 50 per cent. of the gross receipts, such gross receipts must be increased 12¾ per cent. by the introduction of electricity over the whole length of the line, in order to enable the road to pay the same dividends as before.

It may be considered that the results will be changed materially by the use of high-tension transmission throughout. If tri-phase currents at a tension of 10,000 volts were received by each electrical locomotive, the tension reduced by transformers carried by the locomotive, and current employed to operate induction motors directly, or to operate direct current motors through rotary converters also carried by the locomotives, the saving independent of extra transformers and converters would amount to $9,714 per mile, corresponding to $486 interest per mile, and reduce the total increased operating expenses to $3,380 per mile, which would require that the gross receipts be increased 10.2 per cent. in order to pay the same dividend as before, instead of 12¾ per cent., for combined high and low tension transmission. The saving in dollars is quite large, but the total costs are so enormous that the saving makes but a small difference in percentage. It will similarly be seen that differences in kind of apparatus employed will have very little difference on the general results, though the savings are important in themselves.

It must be recollected that these results are based on providing electric traction for the whole length of a trunk line. It can hardly be expected that the gross receipts for the whole line will be increased, say, one-eighth by such an application. If, however, the application be made within the radius of suburban traffic such an increase is not only probable, but it may be expected that the cost of operation per passenger mile will be reduced in greater proportion than stated, so that the application of electric traction will pay from the outset. These considerations will apply to longer distances on railroads like the New York, New Haven and Hartford, where the passenger business furnishes the larger proportion of the income.

Again, it is possible to accomplish with the electric locomotive results that are impossible with the steam locomotive. The power for the former being generated originally in stationary boilers, or in some localities derived from waterfalls, is not limited, and the power of the motor can be increased indefinitely, so that in particular locations a demand either for greater power to obtain more speed, or a greater or more continued tractive force than is now possible with a steam locomotive, can be met by electricity without difficulty.

On the whole, therefore, although the application to the whole length of long trunk lines does not seem practicable under present conditions, there is no doubt but that the industry will grow in the future as certainly as in the past.

A LONG ROAD FROM MILWAUKEE.

The Milwaukee, Racine and Kenosha Electric Railway Company, with headquarters at Racine, has filed articles of association with the Secretary of State with the purpose of building and operating an electric street railway system from South Milwaukee northerly through Cudahy and the towns of Lake and Oak Creek, then south through the towns of Caledonia and Mt. Pleasant, city of Racine, towns of Somers and Pleasant Prairie and city of Kenosha. The capital stock is $250,000; incorporators, George H. Hopper, Edmond Deane and Park Phipps. The officers are M. Slush, president; A. W. Bishop, vice-president, and G. J. Hoffman, secretary and treasurer. The plant is now in process of construction. There are 16 miles of circuit and two of "Figure 8" size No. 3. The power plant comprises two 400 kilowatt Westinghouse generators, two 600 horse-power Westinghouse engines and 1,200 horse-power of Stirling boilers. The road equipment comprises six 100 horse-power Walker motors.

A LONG ELECTRIC ROAD FOR CALIFORNIA.

Mr. John F. Byxbee, the secretary of the Santa Rosa & Sonoma County Electric Railway Company, writes us that a franchise has been granted for this interesting enterprise. The road is to make a circuit of 110 miles through the Sonoma and Napa Valleys, uniting two of the most fertile and prosperous regions in the State. The company is pushing its plans forward actively, and expects to begin construction in 60 days on the first section of 30 miles, from

Santa Rosa to Sonoma City. That section is to be ready by June, 1897, in order to take care of the large summer travel. It is expected that about three years will be required to finish the whole road. Mr. Byxbee's headquarters are at 42 Market street, San Francisco.

MODERN OVERHEAD CONSTRUCTION.—II.

BY BENJAMIN WILLARD.

(Concluded.)

THE holes for eye bolts should be bored in wood poles before their erection, and should be bored so that the bolt will incline slightly downward toward the eye to prevent the water from following in and rotting the top of the pole. The correct location for eye bolt holes would be determined by the height at which the trolley wire is to be placed, 22 feet from the base of the pole would be correct, assuming that we allow 2 feet for drop in the ear body and ear and also dip in the span which would make the height of trolley wire about 20 feet. To facilitate the setting of poles to a uniform height it is a good plan to place grade stakes near the location selected for poles indicating a given height relative to the grade of the track.

Center pole construction is required in many locations and may be more adaptable than other methods, but I consider span construction better, owing to its flexibility and for being less unsightly. There are now on the market appliances for making bracket suspensions flexible, which are an improvement over the old type of rigid construction. One of the most practical which I am familiar with is an attachment to receive a short span of flexible wire and the ordinary straight line hangers.

Poles used for center and bracket construction should be made according to the same specifications as those used for span construction, excepting that an ornamental pole top would be required for the steel pole instead of an insulated one. Much can be spent on ornamentations on center and bracket construction, but it always occurred to me that the most practical is ornamental enough and places the cost where it will do the most good. For the bracket arm a 1½ in. pipe of the required length attached to a malleable iron collar made in halves and encircling the pole and supported by truss rods leading from the end and center of the arm to near the top makes excellent and neat appearing construction.

Wherever guard wires are required, it will be necessary to leave about 2 feet additional space on the top of the pole above where the trolley span wires are attached for the attachment of the guard wire span. It would hardly be practical to provide an insulated pole top to provide for both span wires, so the trolley span would be supported by means of a wrought iron clamp collar encircling the pole at the proper point and provided with suitable insulating fastenings. I do not especially approve of this method of construction (as I do not favor guard wires), but I would recommend it where it is compulsory to erect guard wires.

All poles should be painted with one coat before their erection, as it affords better opportunities to carefully apply the priming coat and at less expense than after the poles are set. A paint of dark green composed of graphite mixture I find to wear well, and although it costs more than some other paints, it has better lasting qualities, especially in iron work. A second coat of this paint, after the poles are erected, will cover marred places made necessary in setting, and will look well and last for at least two years.

Span Wires.—Span wires necessary for trolley suspension should be flexible steel 5-16-inch in diameter, composed of 7 strands of No. 12 galvanized wire, and when under strain with conditions of pole setting, as I have stated, would have a tension of about 750 pounds when erected. Whereas I have allowed 18 inches for sag in the span, it probably would not be over 12 inches at the time the wire is first suspended, but will gradually sag more as the wire stretches and the poles spring or yield in the ground, so if a 40-foot span is attached 22 feet above the rail surface the trolley wire within the course of a year would measure approximately 20 feet above the rail.

Where wood poles are used, or wood pole tops for steel poles, the ordinary ⅝ inch x 12 inch eyed-bolt threaded 4 inches answers every purpose for the attachment of the span wires, and other devices more expensive used for the same purpose are not necessary. Poles when properly set will bear a given strain on the span wires for many years without much yielding, consequently an adjustable device is rarely if ever used. Hard drawn copper trolley wire of No. 1/0 B. & S. gauge has been found to be the most practical dimension of wire and is generally considered a standard for most trolley construction; therefore, overhead appliances are made of various manufacture to meet such requirements. There has been a trolley wire recently manufactured in the form of a figure "8," which is now in use on some roads and has given very good results. Where this wire is used it leaves a perfectly unobstructed surface for the trolley wheel and gives greater current carrying capacity, but in modern construction the hanging appliances have reached such a degree of perfection that the round wire can be used with equally good results, and as the trolley wires on large systems are relied upon but little as a conductor for current capacity, I can hardly recommend anything that would be more practical than the round wire.

Span wire hangers and insulators are of various forms and compositions, and many possess equal merit, and I would recommend for straight line work those most indestructible and possessing the best insulating qualities. The best forms of such hangers are those where the insulation is concealed from the weather as much as possible, and having a metallic covering to prevent them from being broken by accidental contact of the trolley pole. Brass hangers are more expensive than iron, but resist the moisture and are maintained at much less expense. Iron hangers if kept in good condition should be painted at least once a year, as the oxidation, if allowed to accumulate, will form a conductive contact between the conductors and span wires, and in course of time will cause the escape of current by leakage. Hard rubber insulation for hangers is more expensive than many other compositions, but from my experience must say it has fine insulating qualities, and stands different conditions of climate with little or no deterioration.

Suspension ears are of as many varieties as hangers, and I have experienced the use of many such appliances and have concluded that a little modification of the old brass solder ear is the most practical and lasting of all, if properly attached. A solder ear should be 15 inches in length tapped for ⅝ cap bolt and provided with thin lips at either end, so dimensioned as to encircle but little more than half the trolley wire, and one point which should be observed very particularly is to have the ends of the ears ground to a thin tapering end, so that they will become flexible with the vibrations of the wire. If the ends are made heavy or unyielding, the vibrations will have a tendency to detach the ear at the points, and when this takes place it is a question of a short time before the ear is wholly detached.

Insulators and hangers for curve construction like straight line material, are of many designs and permit of wide selection. However primitive may seem my ideas of this particular part of construction, I can only give good results from my experience. I favor what is known as the goose-neck hanger, which is simply a ⅝-inch steel forging formed of such dimensions as to allow good clearance for the trolley wheel and fastened to the soldered ear in a manner to permit it to swivel, also provided with an eye for the attachment of pull-over wires. Such devices are strong, and do not present an unobstructive object for the trolley to catch in. There is no insulation attached to such ears and this is the only thing in their disfavor, but as there are many insulating devices, which can be attached to the hanger, to overcome this difficulty, this could be considered a minor point.

A great deal could be said about overhead curve construction, but there are so many different conditions to meet I will simply conclude my description with a double right angle curve of 60 and 50 feet radius. The pull-off ears should be placed 11 feet 8½ inches apart on the outside curve, and those on the inside curve 9 feet 10 inches apart from center to center (commencing at point of curve), so that the pull-off wires between the two curves run longitudinally from the axis of the track curves. The three central pull-off wires leading to the center pole would terminate in an iron ring 3 inches in diameter fixed at a point about 20 feet from the trolley wire and attached to a single ⅜-inch cable fixed to the center pole by ending in a strain insulator. Each of the other pull-off wires would lead directly to their respective poles, all ending in a strain insulator fastened to the pole top. Each of the suspension ears should be placed directly perpendicular over the track centers and each provided with a strain insulator between the trolley wire and pole.

There is a wide difference of opinion relative to the arrangement of sections and the methods of feeding such sections of the trolley wire. In many installations a practice is made of leading each individual section feeder to the station and separating the trolley into sections by sectional insulations, making it possible to cut out the various sections at the power house. This is a convenience in one respect, and that is, it makes every section of the line directly controllable from the power plant; but there are other things equally as important to consider which may convince you that better results are obtainable through another method, and that method would be to have every feeder on the whole line doing a share of work

at all times, whether the cars be assembled on one section or distributed over the entire line. This, of course, can only be done by means of connections representing the whole line as being in one general section, making short sections controllable by external switches. In the first method mentioned an accumulation of cars may be assembled on one section not estimated for carrying an abnormal load, consequently the feeder would be overtaxed on this particular section, whereas the feeders on others sections would be doing little or no work, consequently, an unevenness of potential between the adjoining sections. If there is a bridge around each section insulator connecting each section together and connected by a feed wire so that the current will equalize itself between two sections the current will distribute itself from all feeders; then we have a small amount of variation of potential from section to section, and every feeder is auxiliary to each other.

I have observed in most all instances that when an accident occurs to a trolley wire the whole line is for a time disturbed in its service until the proper attention has been given to the external circuit where the trouble occurs, and those on the ground are the ones who are depended upon for relief before the forces at the power house are aware of the extent of the trouble, and the switchboard tenders are always under instructions or advice from the emergency crew. Consequently, I maintain that efficient external line appliances that are controllable by emergency forces meet the most important requirement, and the most efficient line can be built with a general feeder system leading from the switchboard and controllable as a whole for each individual line, and not separated into sections requiring separate feeders for each section leading from the station. To accomplish this method of uniting the trolley sections the line is divided into sections by means of sectional insulators, each section so proportioned as to meet the estimated feeding point where the feeder is to be attached. A switchbox is placed on the pole (at a convenient height), in which are contained two switches and fuses, one for the section on either side of the sectional insulator; the feeder is then divided by connection through each switch so that the feed wire delivers current to either section through feeder span wires attached to connections on each side of the sectional insulator. When the entire line is in operation there is an equalization of current in all sections and the trolley remains virtually as a solid conductor, but with all necessary features for disconnecting the sections.

Feed wire distribution is an important item in all installations and varies with local conditions such as distances, amount of work to be done, and cost of producing power. As this is a mathematical problem that is made fitting to meet each of the local conditions, I will only undertake to define a general system for erection and distribution.

In most localities where a large system of feed wire distribution is required it is necessary to erect special construction for that purpose. The most economical plan is to select centers of distribution reached by the most direct routes from the power station and established at such points that may be called junction poles to which are attached the heavy trunk line feeders leading from the power plant, and smaller feeders for distribution to the trolley line. By this plan we may erect wires of 500,000 or million circular mils capacity from the plant to the junction pole, and end same to a junction frame or frames attached to the pole which is provided with a bus-bar of sufficient carrying capacity to carry the current of the branch feeders. The large cables are dead ended in the junction frame by use of eye-bolts and strain insulators, and connections are made with the bus-bar with copper tee connections. The branch feeders are ended and connected in the same way, so that it is possible with little delay to cut out any feeder and make changes which are often necessary during progress of operation.

Southern pine cross-arms, 5 inches by 3½ inches, bored to receive 1½-inch pins, and doubled on each pole, will make sufficiently strong construction to receive the heaviest wires. The pins should be of locust wood bored to receive a ½-inch bolt, which should extend vertically through the center of the pin and terminate with a washer and nut on the under side of the arm.

Top grooved glass insulators are desirable in all classes of heavy feed wire construction, and their adoption is to be recommended. Feed wire conductors of larger area than 0000 B. & S. gauge should be in stranded or in cable form triple insulated with the best waterproof covering. Care should be taken in splicing cables, so that an even strain is brought on each smaller wire and that they are are not allowed to remain without good contact, and that all flux used in soldering is carefully removed before tapeing. Devices have been used for connecting cables, but none are to be recommended in favor of the splice made with the cable itself.

Protection from lightning is now occupying the attention of many railway companies, and there is a wide difference of opinion relative to merits of lightning arresters and their application. I have received correspondence from many different railway companies, and in one instance there are two arresters located for forty-two miles of road, whereas in another instance there were six to the mile. The general idea seems to be two to the mile, and situated at or near the junction where the feed wire is attached to the trolley wire. It is somewhat difficult for me to explain all the details of construction in a manner to be digested intelligently in the mind without referring to some illustrations covering the points in question, so I have furnished the association with some photographic illustrations which may be used in conjunction with my description.

ELECTRIC TRACTION FOR KINGSTON, JAMAICA.

Kingston, the capital of the British West Indies, with a population of about 50,000, is going to put in a trolley system. The Jamaica Street Car Company, Limited, has applied through the Hon. S. C. Burke, its president, and Mr. H. E. Squire, its secretary, for permission to equip the lines electrically. About ten miles will be built. The company is an old and prosperous one, having operated for many years past, using mules as motive power.

TROLLEY TO LEAGUE ISLAND FROM PHILADELPHIA.

A director of the Union Traction Company, when asked whether the company would view favorably the matter of the construction of a branch to the League Island Navy Yard, as suggested by the report of the Committee of Councils, said he could not speak for the Board of Directors, but thought the project might receive favorable consideration if City Councils removed some of the expensive conditions which are attached to trolley franchises granted in the last three years. A line to League Island from Jackson street, constructed in a substantial manner, but laid with "T" rails, without paving and the feed wires overhead, would cost, it is said, in the neighborhood of $20,000, and at the present time there would be little travel beyond what goes and comes from the Navy Yard.

MECHANICAL.

THE AMERICAN MECHANICAL STOKER.

BY C. H. BIERBAUM, M. E.

AMONG the modern engineering developments in the line of mechanical stokers, may be mentioned one of special interest the "American Stoker" made at Dayton, Ohio. The accompanying cut, Fig. 1, illustrates the single stoker.[1] Immediately beneath the coal hopper, and communicating with it, is the conveyor chamber, this in turn communicating with the magazine in direct line with it. A screw conveyer, or worm, is located in the conveyer chamber and extends nearly the entire length of the magazine. Immediately beneath the conveyer chamber is located the wind-box, having an opening directly beneath the hopper. At this point is connected the piping for air blast. The other end of the wind-box opens into the air space between the magazine and outer casting or envelope.

The upper edge of the magazine and envelope are surmounted by tuyere blocks, these tuyere blocks being provided with openings for the discharge of the air blast. Beneath and in front of the hopper, is located the motor for operating the stoker. These motors are simple piston steam engines. The piston rod of the motor carries a crosshead, which, by means of suitable conecting links, operates a pawl mechanism, which in turn actuates the ratchet wheel mounted on the conveyer shaft.

The space on each side of the stoker, between the tuyere blocks and the side walls of the furnace, is occupied by dead-plates, or an air-tight grate.

Furnaces over six feet in width, too wide for a single stoker, are equipped with the double stoker, shown in Fig. 2. This double stoker is the combination of two single machines, feeding from a common hopper. and operated by the same motor. The coal is fed into the hopper, carried along by the conveyer through the magazine, overflows from it on both sides, and spreads upon the dead plates the entire width of the furnace. The entire mass of coal above the tuyere blocks and all of that upon the dead-plates is ignited, carrying a bed of burning coke from fourteen to eighteen inches in depth.

In the usual hand firing conditions the natural tendency for

[1] An illustrated article descriptive of this apparatus will also be found in The Electrical Engineer, Vol. XX., No. 395, Nov. 27, 1895, p. 535.]

the air is to pass through the bed of coal, where it finds the freest and easiest passage. This would be at the points where the bed of coal is the thinnest, where naturally the least amount of air is required; and, conversely, the least amount of air is supplied to the parts of the fire where it is thickest, where the greatest amount is required. This tendency has the effect of burning holes into the fire. By common experience, every practical fireman knows that a fire with these holes burnt in it is wasteful, owing to the excessive admission of cold air into the furnace.

In order to overcome this wasteful tendency, frequent slicing and firing is required. This, in turn, requires the fire doors to be opened at short intervals, and again means an admission of a large quantity of cold air through the fire doors, thus the waste due to an excessive use of air cannot be avoided under the ordinary conditions of firing, though care may greatly reduce this loss.

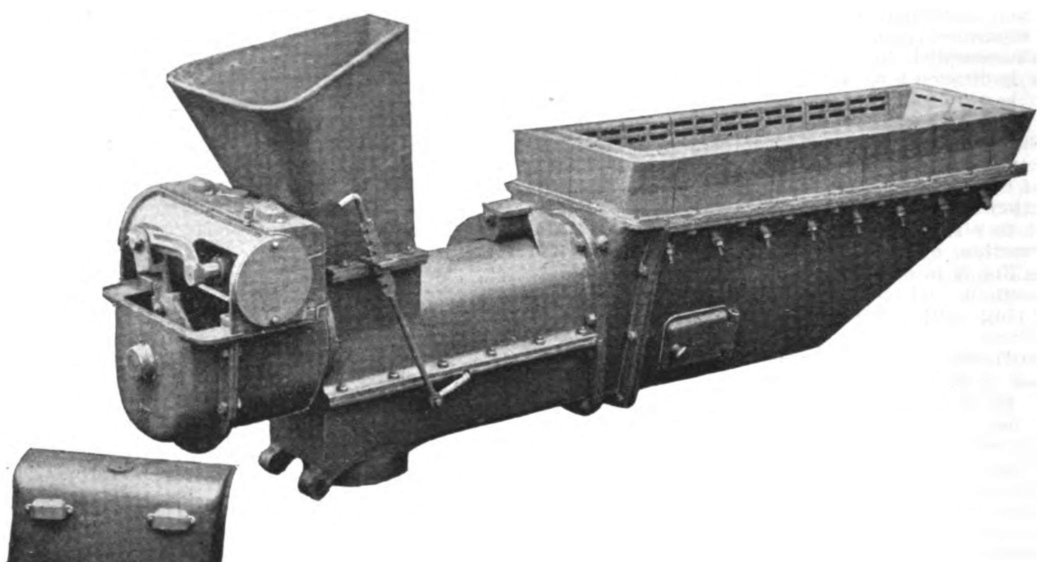
The greatest loss in any boiler plant is the loss of heat carried away by the chimney gases. This, to some extent, inevitable loss, in common practice amounts to from 15 to 35 per cent. of the total heat generated in the furnace. The temperature of the chimney gases depends upon the temperature of the absorbing surfaces and the velocity at which these gases sweep over these heating surfaces.

It is, therefore, evident that the temperature of the gases must be higher than that of the absorbing surfaces, i. e., the temperature corresponding to the steam pressure in the boiler; largely detracting from the value of the stoker as an economical adjunct.

Another economic feature of this stoker is the complete combustion of both the solid and gaseous portions of the coal. The bed of burning coal being deep and having forced draft, melts the incombustible portions of the coal into a clinker, which accumulates on the dead-plates on both sides of the furnace in a compact mass, almost entirely free from any trace of coke. The comparative results show that the amount of ash is reduced from 2 to 8 per cent. This means that the amount of coke and coal in the ash is reduced by an amount equal to the reduction of the per cent. of ash, and since a pound of coke is worth more than a pound of ordinary coal, the per cent. saving, due to non-waste of coke ash.

It is quite evident that none of the gaseous constituents of the coal can escape perfect combustion under the conditions of operation. The green coal being fed from below the bed of fire, liberates its hydro-carbons or gaseous constituents upon coming in contact with the fire. The air being supplied at this point where the hydro-carbons are evolved, is thoroughly mixed with them, this mixture then passing through the deep bed of incandescent coal.

A problem next in importance to that of the economic use of coal, is perhaps that of smoke prevention. Large sums of money have been expended in experiments, without a sufficient regard to the simple laws of smoke formation. Smoke



The New American Stoker.

the lowest possible temperature that could be attained would be that of the heating surfaces if the gases had no appreciable velocity whatever. Thus, in order to reduce the chimney losses under given conditions, it is necessary to reduce the volume of air used, in other words, use the air more economically.

As the result of a long series of chemical analyses of these chimney gases collected under precisely similar conditions, both when fired by hand and by the stoker, it is shown that the amount of air required per pound of coal when burned with this stoker is from 20 to 55 per cent. less than that which would have been used in the common hand fired practice. This effects a twofold economy, in decreasing the volume of heated gases passing up the chimney and likewise decreasing the velocity of the gases as they pass over the heating surfaces, thus allowing more time for the absorption of heat by the boiler surfaces. Therefore, the increase of economy must somewhat exceed the product resulting from multiplying the actual percentage of decrease of air used by the corresponding chimney losses.

This economic use of air is due to the method of operation peculiar to this stoker, in that it carries a bed of coal of unusual depth, the air being supplied from underneath, the volume of which, being under perfect control, and the continuous feeding action, completely overcoming the natural tendency of holes burning through the fire.

In point of construction, it is notable for the fact that no mechanical part of the stoker is subjected to heat. One of the chief objections found in all types of mechanical stokers has heretofore been that the mechanical parts were so subjected to heat as to render frequent repairs necssary, thus

is always the result of the incomplete combustion of hydro-carbons, whatever the fuel may be from which it has been distilled.

Smoke is a current of the gaseous products of combustion holding carbon in a very finely divided state in suspension. The intensity of the color is but an indication of the amount of carbon the smoke contains. In general, the process of smoke formation is this: The heat of the fire distills the hydro-carbons, and these in the presence of the air supply are broken up into their constituent elements, hydrogen and carbon. Hydrogen, the gaseous and more inflammable constituent, ignites readily; carbon, the solid constituent, requiring a white heat for ignition, passes off as soot.

If, on the contrary, the hydro-carbons with an admixture of air, pass through a white heat, the carbon cannot escape combustion, and thus the formation of smoke is made impossible. These conditions exist in the operation of this stoker. The hydro-carbons are liberated beneath the deep bed of incandescent coal, there in the presence of the air supply decompose, and the constituents mixed with the air, together pass through this bed of coal, the intense temperature of which is sufficient to thoroughly burn the liberated carbon. Thus theoretically and practically smoke-prevention is made a success.

The labor of the fireman is materially decreased, in that his duties are simply keeping the hopper filled and drawing the clinker at intervals of from six to twelve hours, depending upon the rate of firing and the grade of coal used. The clinker accumulating upon the dead plates on both sides of the furnace, presents no obstruction to the air supply, leaving the fire constantly in such a condition where at any

moment it may be forced, and thus be made to respond instantly to a sudden increased demand for steam.

The wide application of this stoker is no less a feature of interest. Not only has it been made a success under all types of steam boilers, but it is likewise equally well adapted and successful in puddling furnaces and heating furnaces, retorts and furnace work generally.

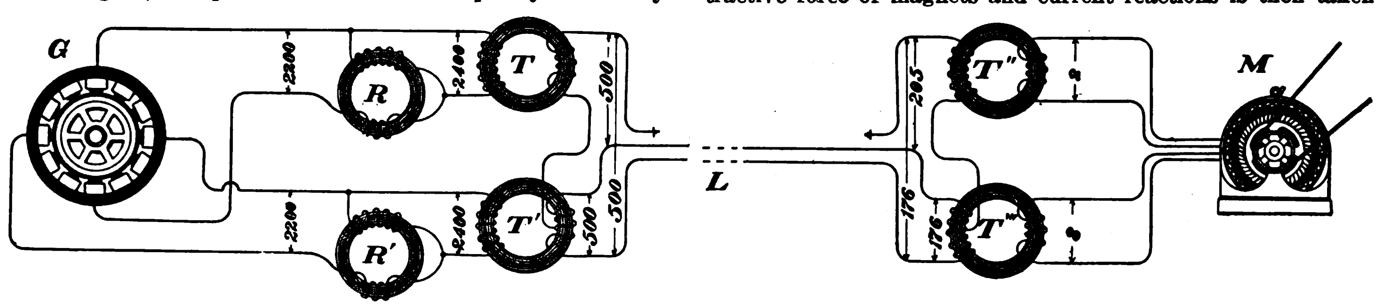
POWER TRANSMISSION.

THE NIAGARA-NEW YORK POWER TRANSMISSION AT THE ELECTRICAL EXPOSITION.

THE report of the nineteenth convention of the National Electric Light Association has just been issued by Secretary Geo. F. Porter, and presents a handsome appearance. Besides containing in full the papers read before the association at its last meeting in May, together with complete illustrations, it gives an excellent résumé of the salient features of the late Electrical Exposition, including the official reports of the companies engaged in the telephonic transmission of the roar of Niagara; of the companies over whose wires messages were sent around the earth; and the report of the transmission of power from Niagara to New York for the operation of the model of the great Niagara power plant. Among the latter is the report of Mr. L. B. Stillwell, electrical engineer and assistant manager of the Westinghouse Company, which contains some details of this remarkable work not heretofore published. Mr. Stillwell's report is given in abstract below:

The energy was transmitted by three-phase alternating currents: two of the conductors of the three-wire circuit were telegraph wires furnished by the Western Union Telegraph Company; the third was the earth, through ground connections in the power house at Niagara and in the Exposition building, New York City.

At Niagara, two-phase current at a frequency of twenty-five cycles per second and a potential approximating 2,200 volts was obtained from one of the 5,000 horse power generators of the Niagara Falls Power Company.



NIAGARA-NEW YORK POWER TRANSMISSION.

Two small transformers, connected in the manner devised by Mr. Chas. F. Scott, and first described by him in his paper read before the annual convention of the National Electric Light Association, in Washington, D. C., March 1, 1894, received the two-phase current and delivered to the transmitting circuits three-phase current. The potential delivered by these transformers, when supplied with a current at 2,200 volts, namely, 450 volts, was found to be rather low for good results, and the potential delivered to the line at Niagara was therefore increased to 500 volts by the use of two small transformers, connected as Stillwell regulators, in each side of the two-phase primary circuit.

The transformers at the New York end of the line were of the dimensions of the standard three-kilowatt Westinghouse transformer, but they were designed to deliver only fourteen watts each, and the energy required to magnetize the iron core was less than one and one-half watts. The energy lost in the copper, when the transformer was delivering fourteen watts, amounted to only one-quarter of one watt.

By actual test, the energy required to drive the motor was eight watts. The clearance between armature and field was one-fiftieth of an inch. No very accurate measurement of the power developed was taken, but when the line was in favorable condition, that is, when the weather was dry and the leakage consequently low, the power developed was probably about one-thirtieth of one horse power. The motor was of the induction type and wound for two-phase currents. The electrical specifications for this motor were made out by Mr. B. G. Lamme.

The specifications for the transformers were made out by Mr. J. B. Whitehead, under the immediate supervision of Mr. Chas. F. Scott, the electrician of the Westinghouse Company.

Referring to the diagram, G is the 5,000 horse-power, two-phase generator; R and R', the regulating transformers; T and T', the two-phase, three-phase transformers at Niagara; L, the line or transmitting circuit; T'' and T''' the three-phase, two-phase transformers in New York; and M, the motor.

The potentials given in the diagram are closely approximate for the Niagara end of the line; for the New York end of the line they roughly represent what may be called the average conditions of operation.

The potential of the currents delivered at the New York end of the line varied between rather wide limits, from one night to another, depending apparently to a very considerable extent upon the leakage from the line, as influenced by atmospheric conditions. The alternating-current motor was operated satisfactorily, potentials at the New York end of the line increasing when the motor was connected to the circuits. This effect was probably due to capacity of the circuits being counteracted by inductance when the motor and step-down transformers are connected; the current then more nearly coinciding in phase with the impressed electromotive force.

LITERATURE.

APPLIED MAGNETISM—By J. A. Kingdon. London, H. Alabaster, Gatehouse & Company; New York, D. Van Nostrand Company; 292 pp; 5½x8½. Price, $3.

It has been the author's object to avoid, as far as possible, mathematical formula, and though he has fairly well succeeded in this respect, it is evident that the subject in hand cannot be thoroughly handled without it. The book begins with a description of the general principles of magnetism, including magnetic flux, magnetic reluctance and permeability, etc., leading up to Hopkinson's law, and the calculations for leakage, etc., and this is followed by chapters on electromagnetic force and magnetomotive force of currents. The tractive force of magnets and current reactions is then taken up, and the experiments of Bosanquet, permeameter tests, etc., are given, in each case accompanied by actual examples worked out, showing the application of the formulae.

Under the head of qualitative magnetism the author discusses the various relations which exist between the direction of flux and the poles, between the exciting current and the magnet and its flux, and similar relations between current and magnetism. By rules and illustrations, these various relations are made plain. Under the head of "Alternators and Dynamos" the author treats respectively of the principles underlying the calculation of the principal elements of alternating and direct current machines, but as both are dynamos in the accepted sense of the term, it does not appear why the distinction in terms should have been made. Additional chapters of the book take up the subject of commutators and collectors, hysteresis and heating of armatures, alternating magnetic flux, under which heading the transformer receives brief treatment. Under "Electro-motors," the author, after a brief account of the underlying principles of their operation and construction, describes a number of practical applications to stationary power purposes, as well as to electric traction, and the propulsion of boats. Polyphase current also comes in for brief mention, and the book closes with two chapters on magnetic measurements and calculation in inch measurements.

We cannot say that the book is likely to prove of great value to the reader. In attempting to present the subject in a more or less elementary and popular style, something had, of necessity, to be sacrificed. We believe if the author had confined himself to either method of treatment of the subject, he might have rendered it more of a success than has fallen to his share in making a straddle.

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CONTENTS.

INTERESTING TELEPHONE LITIGATION.

THE suit of the United States vs. the American Bell Telephone Company and Emile Berliner, for the cancellation of the Berliner patent No. 463,596, reached a hearing before the Supreme Court on Monday, November 9. On account of the importance of the case the hearing was extended from the customary four hours to nine. We call the attention of our readers to a summary of the arguments presented before the Supreme Court to be found on another page of this issue. It will be remembered that this famous suit was authorized by President Harrison, and was begun in February, 1893, by the Attorney General on behalf of the United States. Its object is to cancel the patent, for which application was made on June 4, 1877, by Emile Berliner, and which was issued after fourteen years of delay in the Patent Office, on November 17, 1891, to the American Bell Telephone Company, assignee. The patent is understood to cover the mode of operation and apparatus of the microphone, or battery transmitter, that is, all known forms of transmitters which are adopted for commercial use. Under its protection it appears that the American Bell Telephone Company may continue its monopoly of the telephone business until the year 1908.

The suit was brought in the Circuit Court, District of Massachusetts, and on January 3, 1895, Judge Carpenter decided in favor of the United States and ordered the patent canceled. The American Bell Telephone Company brought the case on appeal to the Circuit Court of Appeals, District of Massachusetts, and won the decision, Judge Carpenter being overruled by Judges Putnum, Colt and Nelson. The United States then appealed the case to the Supreme Court. An early decision is expected by both sides, and anxiously awaited by the public.

We also make note in this issue of the victory just won by the opposition telephone interests in having the Watson switch patent set aside. Those who chose to fight this instead of "knuckling down," are certainly entitled to great credit for exposing the invalidity of a patent which has popularly been assumed to have great merits as a Bell bulwark. As a matter of fact, the resort to the Carty bridging bell method has shown the Watson hook and induction coil circuit not to be so vital and essential as it was assumed to be; but independent manufacturers did not wish in avoiding Watson to come into collision with Carty, and thus more or less of an actual blockade ensued. The present situation is that another of the barriers against free telephonic work has been removed, and to that extent the independent manufacturers and exchanges are benefitted, and the public as well, by the opportunity for greater competition.

The Watson switch patent, No. 270,522, now invalidated, has eight claims, but the pith lies in the first two here quoted:

1. In combination with suitable contact-points and springs electrically connected with the call-circuit and the primary and secondary circuits of the transmitter, the latter circuit, including the hand telephone, a lever electrically connected with the main line in a telephone circuit, substantially as described, to bring in the hand telephone and transmitter and break the call circuit, or to cut out the hand telephone and transmitter and establish the call circuit, accordingly as the lever is moved in one direction or the other.

2. In combination with suitable contact points and springs electrically connected with the call circuit and the primary and secondary circuits of a transmitter, the latter, including a hand telephone, a lever electrically connected with the main line and provided with a hook to support the hand telephone, and a spring tending to overcome the weight of the hand telephone, substantially as described, to bring in the hand telephone and transmitter and break the call circuit, or to cut out the hand telephone and transmitter and establish the call circuit, accordingly as the hand telephone is removed from or hung upon said hook.

THE DECADENCE OF THE MANHATTAN ELEVATED.

THE annual report of the Manhattan Elevated Railroad, just issued, would indicate that the patronage of the road was going from bad to worse, and that the long period of inactivity and conservatism in the management of the system was fast bringing it to ruin. This is a matter of deep regret, for it affects New Yorkers vitally and makes them bitter, although they have no natural ill will towards the company. The falling off is attributed to the competition of the Metropolitan Traction Company, but this is hardly true, as that would have been found to be a means of actually increasing the traffic had the elevated responded to competition with a brisker, brighter, better service. To show what the elevated has been losing, we give below a statement of comparisons for the last five years, each year ending September 30:

Year.	Gross.	Net.	Passengers.
1896	$9,352,115	$3,224,786	183,437,244
1895	9,745,927	3,613,100	188,072,645
1894	10,138,143	4,042,586	196,159,323
1893	11,137,051	4,926,891	219,621,017
1892	10,908,579	4,943,690	215,122,575

It will be seen that in these five years the elevated road has lost progressively, until this year the number of passengers is 36,000,000 less than in 1892, or, say, 100,000 a day. Yet the city has, meantime, increased vastly in area, wealth, in population, and in that diversity of interests, amusements and functions which does so much to foster travel. Why, then, should the service have failed to secure as large a patronage unless it is falling below its opportunities and its responsibilities?

It is known that the elevated is now "experimenting" with electricity and compressed air, but why it should have to "experiment with electricity" at this late day is a deep mystery and a marvel. Of course, there are conditions and difficulties peculiar to the work, but they could have been met long, long ago, had the company chosen to do a little for itself instead of throwing all the cost of preliminary work upon the people desirous of getting its contract. To-day we have successful elevated electric roads in Liverpool, Chicago and elsewhere; successful underground electric roads in London and Buda Pest; some 1,500 electric trolley city and long distance roads all over the world, carrying annually far more than the population of the globe, and yet the cautious, fossilized management of the elevated keeps on prating about the dubious nature of electric traction!

Some estimable gentlemen have just been elected to the elevated directorate, but as they are Gould-Sage men, and as that means a continuance of the old regime of poor service, timid inactivity and declining revenues, we fear New York cannot expect much improvement in that quarter. It is preferable to travel in the open air, but the necessity for the proposed underground electric road is daily rendered more obvious through the policy of those who should render its construction superfluous by their efficient provision for business waiting to come to them.

THE AMERICAN BELL-WESTERN UNION AGREEMENT.

IT is only to be expected that the present relations of the Western Union and American Bell Companies should remain the subject of a good deal of curiosity. The old agreement, whose terms have appeared in full only in these pages, has not been succeeded by another, if we are to believe the statements of parties directly interested; yet where two lines of industry are so closely related as are the telegraph and telephone, there must be some kind of understanding in the very nature of things. The old agreement arose out of a perception of that fact, and the Western Union Company only abstained from telephonic work upon the easy terms of receiving a large sum of money to sit still, while the telephone companies were to leave its field undisturbed. The payments to the Western Union by the American Bell up to date have probably reached $8,000,000, and have run up to $690,000 a year. This money the Western Union stockholders lose, and it now goes into Bell stockholders' pockets, to that extent materially swelling the one dividend, while reducing the other. It is obvious that the Western Union would like to find a source of income that would yield a like amount, and this it might obtain from a telephonic business of its own, such as it had in the old days prior to the agreement; but this would simply invite sharper competition from the Bell telephone service, and meantime the Berliner patent has not been thrown open, so that an element of uncertainty awaits any such investment just now. Besides, the Postal Company could readily effect an operating alliance with the Bell interests, and it has even been intimated that "Barkis is willin'." It would be pretty hard for the Western Union to make ends meet under those competitive conditions.

After all is said, there remains the fact that such large interests and such large masses of capital do not fight when there is a better way out. Both parties may agree, or may have agreed already, to keep within their familiar fields for a further term of years.

NIAGARA TO BUFFALO.

DURING the present week, indeed, even before these lines have been published, it is expected that the Niagara current will be delivered in Buffalo for regular consumption, over the circuits of which we gave some interesting views and data a few weeks ago. Pending the delivery of current in Buffalo, a great many uses of it have been developed around the falls, but it is the transmission to Buffalo that has chiefly engaged the thoughts and fancies of the public, and has, in reality been the goal of the courageous men to whom the great undertaking is due. Congratulations are certainly in order, not only to those engaged in the enterprise, but to Buffalo, whose future is brighter than that of almost any other city in the Union. It is true that we are still at the beginning of the utilization of Niagara, but a very definite and hopeful beginning has been made.

MOTORCYCLES.

WHILE the motorcycle industry in this country does not yet betray any great signs of activity, Europe is witnessing a brisk development. Even if we discount a great deal of the newspaper talk, enough fact remains to show that the art, still so young, has taken firm foothold. The parade of horseless vehicles in the Lord Mayor's show in London, for the first time, was a notable event, and it has now been succeeded by a highly interesting race from London to Brighton, in which an American vehicle won. In France similar activity prevails. Mr. Ingersoll, editor of the "Horseless Age," informs us that the European investment in motorcycle building already reaches $10,000,000, and that many of the new factories are hardly yet in full production, so that the number of such vehicles in use is not a criterion of the number that will be seen next year.

It is worthy of note that the Duryea motor winning in England was easily beaten by two electric vehicles at the recent Providence races, where the distances were short. As a long distance vehicle it has evidently various recommendations, and in the smooth roads of England it has found favorable conditions denied it on the usually execrable mudways that, under the name of thoroughfares, encircle most American cities just beyond the city limits. Even in the cities our streets need great improvement in paving before the motorcycles, electric or any other, can do their best. The statement in the newspapers last week that the mails in New York City are to be handled largely by horseless wagons is slightly anticipatory, for although one of the papers has illustrated the wagon, we learn that there is still indecision as to their nature and as to their motive power. But they will come presently, and with them better streets.

TELEPHONY AND TELEGRAPHY.

THE BERLINER MICROPHONE PATENT BEFORE THE U. S. SUPREME COURT.

IMPORTANT ARGUMENTS ON BOTH SIDES.

THE suit of the United States vs. the American Bell Telephone Company, et al., for the cancellation of the Berliner patent, No. 463,569, owned by the American Bell Telephone Company came up on Monday, November 9, before the United States Supreme Court. The argument was opened for the United States by Judge Taylor, who dwelt on the following points in detail:

First—The long delay of the application in the patent office.

Second—The relation of the Berliner patent of 1880 to the Berliner patent in suit.

In reference to the delay in the office, it was shown that on June 7, 1877, Emile Berliner filed an application, which, in 1878, came into the possession of the American Bell Telephone Company, and after various amendments and interferences, and after over fourteen years of delay in the patent office, was finally issued on November 17, 1891, to the American Bell Telephone Company, as assignee.

On June 9, 1882, the patent office notified the American Bell Telephone Company that "as at present advised, it is believed that the claims presented may be allowed, but final action in this case must be suspended in view of probable interferences with other pending applications, which will be declared as soon as practicable."

The "probable interference" which was to cause the delay was on the application of Drawbaugh, of July 26, 1880. This application claimed the magneto transmitter and receiver of Bell and the carbon transmitter of Edison. The patent office immediately rejected Drawbaugh's claims, on account of the undisputed and inconfutable evidence of more than two years' prior use of the inventions claimed. Drawbaugh filed an affidavit in which he did not pretend to deny the fact of prior public use, on which the rejection of his claims rested. The patent office should then have passed Berliner's application to issue. However, as President Hudson, of the American Bell Telephone Company, testified, "by common consent" the patent was withheld to await the decision of the Court in reference to Drawbaugh's pretensions as an inventor, not in reference to the prior public use. The evidence in this suit was completed in June, 1884. Judge Wallace handed down a decision in December, 1884, and another in December, 1885, after additional evidence for Drawbaugh had been submitted, both decisions declaring Prof. Bell the true inventor; and finally the Supreme Court in March, 1888, again decided in favor of the Bell Company.

It was the duty of the Bell Company, knowing the impossibility of an interference with Drawbaugh, on account of the prior use of the invention, and previous to the above dates, to demand action on the part of the patent office. It was the duty of the Bell company, after each of the above decisions, declaring Drawbaugh without grounds for his claims as a prior inventor, and their duty each day after the Supreme Court declared his claims void, to demand action from the patent office on the Berliner patent. They did not do so. On the other hand, it was the duty of the patent office to have passed Berliner's application to issue after the rejection of Drawbaugh's claims on account of prior use. It was again the duty of the office to pass it to issue after each of the above dates, when it was seen that Drawbaugh had no rights as a prior inventor.

Instead of so doing, it delayed action until after the decision of the Supreme Court, and then forced Drawbaugh, against his protest, to submit testimony in reference to the prior use upon which his claims had been rejected eight years previously, and concerning which there was no bearing on the issue of the Berliner patent, for Drawbaugh had now no status as a prior inventor. Finally, after more than three years, the Commissioner wrote, on October 29, 1891:

"As this applicant (Berliner) has technically perfected his rights to the allowance of a patent, I think the allowance should issue, largely because well settled principles of public policy forbid us to give any further opportunities for holding this application in the office." On November, 17, the same year, the patent issued.

In rebuttal, Mr. F. P. Fish, of Boston, and Joseph H. Choate, of New York, argued for the American Bell Telephone Company, that strenuous efforts had been made to secure the issue of the patent; that the Bell company had received the patent under the rules of the patent office, and that whatever delays there may have been were due to the patent office and not to the Bell Company, and the defendants should not be held responsible for such delays. Also, that the Bell Company were under no greater obligations than any other applicant to hasten the action of the patent office, and, furthermore, that the delay was not without precedent.

On the other hand, Mr. Causten Browne, on behalf of the Government, argued that, as the duty of the Commissioner was only to issue such patents as did not conflict with the rights of the public, there did exist in this case an extraordinary duty on the part of the company to speed the application by every means known to law, and if it failed to do so, that failure was sufficient grounds for the cancellation of the patent.

The second point argued by Judge Taylor, on the part of the United States, was the double patenting of the invention in question, on account of the patent issued to the same inventor, Berliner, in 1880. The Bell company argue that Berliner's 1880 patent, while covering the identical apparatus of the patent in suit, yet was to be used for an entirely different purpose and operated in an entirely distinct manner, that is, it was a patent for a receiver, while the patent in suit was for a transmitter. The Government, on the other hand, shows that the fourth claim of the 1880 patent was a claim for the identical apparatus of the patent in suit, used as a transmitter and receiver, in combination. Therefore, as this combination of the transmitter and receiver of the fourth claim of the 1880 patent cannot be used without infringing the 1891 patent, there exists a case of double patenting of the transmitter by the same inventor, and the latter patent (the patent in suit) is void under the ruling in the Miller vs. Eagle Manufacturing Company case, 151 U. S.

In addition to these two points argued by the United States, which were the grounds upon which Judge Carpenter adjudged in favor of the United States, in the Circuit Court, District of Massachusetts, on January 3, 1895, and whose decision was overruled by the Circuit Court of Appeals, on the ground of lack of jurisdiction in the absence of fraud, Judge Aldrich, representing the United States as special assistant counsel, argued the following points, set up by the United States, urging the cancellation of the patent: "Berliner's patent, No. 463,569, is invalid and should be cancelled, because the application as filed June 4, 1877, did not describe the constant-contact transmitter which is covered by the patent."

Judge Aldrich argued as follows: I. The history of the application above shows that all the examiners in the patent office, six in number, who actually passed upon the merits of the question from the year 1880 to the issue of the patent, in 1891, found and determined that the application as filed June 4, 1877, did not contain a description of the constant-contact transmitter of the patent.

Berliner stated in his application, as filed June 4, 1877, in reference to those instruments which might operate by constant contact:

"These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sound, such as speech, they are not adapted."

Berliner then describes a double pin transmitter, which is necessarily a make and break transmitter, and claims the transmission of speech by this instrument. Examiners Freeman and Lyons said in reference to this instrument, and in an official communication from the patent office:

"This is the only form of instrument which applicant describes as adapted to the reproduction of other than purely musical sounds." And again: "That the invention disclosed in this case is not a speaking telephone, has been conclusively shown in this answer." The invention spoken of was the single pin transmitter, which the Bell Company claim Berliner meant to describe as adapted for the transmission of speech. The American Bell Telephone Company also argued that, even if the application as filed by Berliner did not contain the constant-contact invention, yet the application as amended in 1877 did contain it, and, therefore, the validity of the patent cannot be assailed.

Judge Aldrich argued that the application as amended in 1877 did not contain the constant-contact transmitter, but that this device was inserted in the subsequent amendments made by the Bell company, the entire specifications and drawings having twice been erased and new ones substituted, but that even if the application as amended in 1877, did contain the invention in issue, yet the patent is void, for Berliner failed to execute and file the oath of the amendments until May 27, 1882, nearly four years after the invention sworn to had gone into commercial use.

2. "The Berliner patent is void, because of irregularities of

procedure in the patent office, aside from questions of delay and insertion of new matter."

Judge Aldrivh showed that the Bell company appealed from the decision of the examiners to the effect that the amendments contained "new matter," directly to the Commissioner, instead of first carrying the appeal to the Board of Examiners-in-chief, as the law requires. The Commissioner decided that the amendments contained no new matter.

The Bell company argued that the Commissioner had final jurisdiction, and the decision would ultimately have been in their favor, even if it had first gone through the Board of Examiners-in-Chief. Judge Aldrich argued that the statutes required the appeal to be carried through the Board of Examiners-in-Chief, and it by no means follows that the Commissioner would have been uninfluenced by the opinion of a board composed, as required, by statute, of "persons of competent legal knowledge and scientific ability."

3. "The Berliner patent is void, because the process and apparatus therein claimed were described by Alexander Graham Bell in his patent, No. 174,465, of March 7, 1876, and were a part of Bell's invention disclosed in that patent." This fundamental telephone patent of Bell's claimed, in addition to the method and apparatus of the magneto telephone, the method of the microphone, or constant-contact battery transmitter. Bell did not claim the apparatus of the microphone, but in May, 1876, he for the first time, successfully transmitted speech and used for the transmitter a constant-contact battery transmitter, or microphone—that is, his liquid transmitter. The testimony of the American Bell Telephone Company in the previous "telephone cases" showed that this liquid transmitter of Bell's was, contrary to the popular opinion, very different from the Gray liquid transmitter, and was in fact, a true microphone, with a surface contact, the variation in resistance being "at the contact of the rod and the liquid." Now, it was known that the resistance of a given contact can only be changed by a variation in the number of molecules in contact at the variable resistance point; in other words, the variation of resistance depends wholly on the variation in area of contact. This was as true of Berliner's microphone as of Bell's. A variation in pressure between the electrodes was as necessary an adjunct in the Bell transmitter as it was in the Berliner. The Bell company claimed that Berliner's microphone operates by a variation in pressure causing a variation in the "intimacy of contact" of the electrodes, while the Bell transmitter depends upon a variation in the "area" of contact. Judge Aldrich argued that a variation in intimacy of contact could only produce a variation in resistance by a variation in the number of conducting molecules, which is a variation in the area of contact. Also, that the Bell transmitter, in addition to its operation by a change in superficial area alone, also operates by means of a variation in intimacy of contact, due to a variation in pressure between the electrodes in constant contact. Therefore, Judge Aldrich argued that the method of the Berliner patent, that is, Claim 1, "the method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described," is identical with the method of the Bell patent and apparatus.

Though Bell failed to patent the apparatus of his method, no subsequent inventor was entitled to a patent on his apparatus or method. Bell successfully transmitted speech by the variable resistance method in May, 1876; Berliner's earliest date of record is January, 1877. Thus, Judge Aldrich argued: "When an art has been covered by a process patent, as the art of telephony by the patent to Alexander Graham Bell, of March 7, 1876, no other process patent can be sustained in the same art, unless the result is accomplished by the application of a new principle. . . . At the most, Mr. Berliner would be entitled to a patent for the very structure claimed by him, which would be valueless, as the Edison and Blake microphones are now public property."

In conclusion, Judge Aldrich called attention to the companions of the Berliner patent in its long sleep in the patent office, that is, the Edison carbon patents which actually expired by English limitation before their issue in this country. These patents claimed broadly the use of carbon for telephone transmitters. The efforts made by the Bell Company to sustain these patents by changing the interpretation of the Revised Statutes, Section 4887, would be recalled by the Supreme Court Decision in the Bate Refrigerator case, upholding this section.

Following the argument of Government counsel, Messrs. McNaught and Redding, representing the Standard Telephone Company, of New York, submitted briefs on the same side of the question. The points argued by them were the following:

1. Mode of operation is not a patentable novelty.
2. The Bell patent of March 6, 1876, covers and discloses the entire art or method, including mode of operation for transmitting speech by means of electrical undulations.
3. The Berliner patent of 1891 is void for the reason that patents covering the same invention were issued in Russia, Italy, Great Britain, Canada, and many other foreign countries to Berliner, Edison and Blake, and these patents had expired in most of those foreign countries before the Berliner patent of 1891 was issued.

Berliner, in his specification filed in the patent office September 1, 1880, said: "The essential part of the apparatus is the point of contact."

Messrs. McNaught and Redding, in their brief, concede the correctness of Berliner's specifications in this particular, and they demonstrate in their brief that the Berliner novelty is in applying Bell's mode of transmitting speech by electrical undulations and his adjustment of the contact between electrodes as described in his patent of March 6, 1876, to Regnault's and Reis's old telephonic apparatuses.

The American Bell Telephone Company's counsel contend that the apparatus described in the Berliner patents of 1880 and 1891 is exactly like the old Regnault and Reis apparatus, and that Berliner's apparatus produced speech while the Regnault and Reis apparatus would not talk.

When the different parts of two machines which are exactly alike are put together and one operates and the other will not, there is something wrong with the one that will not operate. In the old Regnault and Reis structures there were diaphragms and electrodes exactly like those found in the Berliner apparatus; yet the latter talked and the former would not. The reason why one operated and the other would not was not because the parts of the machine were different, but because they were put together differently; and that difference is confined entirely to the point of contact. This, Mr. Berliner says in his specifications, is the essential part of his apparatus. Berliner's novelty, if any, was in applying Bell's adjustment and undulatory currents to the Regnault and Reis ancient apparatus. He simply put together Regnault's and Reis's solid electrodes in the way pointed out in Bell's patent of 1876 so as to prevent a make and break in the circuit.

The Bell Company, in paragraph 7 of its answer in the case now pending before the Supreme Court, avers that this adjustment of pressure between the electrodes is mechanical. Its counsel, in their briefs filed in the case, argue that the principles are not mechanical but electrical. The same counsel, in the trial of the Bell Telephone Cases reported in 126 U. S., at page 278, stated that the principles employed were mechanical and not electrical. The Bell Company's principal expert, Prof. Cross, in his testimony in the case now pending before the Supreme Court, said that the principles employed in the adjustment of pressure were mechanical.

The third point made by Messrs. McNaught and Redding in their brief, was fully discussed in our issues of January 17, 24 and 31, and of February 7, 14, 1894. It was shown that Berliner, Edison and Blake had taken out patents in England and other foreign countries, and that these patents had expired before the Berliner patent of 1891 was issued. At that time the Supreme Court of the United States had not rendered its opinion in the celebrated Bate Refrigerating Company case.

The Edison patents, Nos. 474,230, 474,231 and 474,232, which fully cover and disclose the Edison microphone, are printed in full in the record in the case now pending, and the record shows that they were patented in England as No. 2,909, July 30, 1877, and expired July 30, 1891, or three and a half months before the Berliner patent involved in the present suit was issued.

In reply to the arguments of Messrs. McNaught and Redding, the Bell Company's counsel contended that they could not be made for the first time in the Supreme Court of the United States as they had not been previously brought up in the U. S. Circuit Court and the Court of Appeals.

PROS AND CONS OF TELEPHONE COMPETITION.

REFERRING to the excellent briefs in Saturday's "Evening Post" of the arguments to be heard in the telephone suit this week, is the statement in the third paragraph true that the Berliner and the Edison "are the only patents which stand in the way of the use of the microphone transmitter in good and practical forms?" If that statement is true, then we who are using similar transmitters not supplied by the Bell Company are liable to be called on for explanations and an accounting, if the United States does not win the suit. In

fact, are we not present transgressors and liable at any moment to be involved in litigation?

For two reasons I seriously doubt the correctness of the statement. First, because the company from whom we purchased our telephones gave up a written guarantee that there was no infringement, and also agreed to protect us from all expense should litigation for infringement of patents follow the establishment of our exchange. And (second) because ex-Solicitor-General Aldrich, in interviews as reported by representatives of the press in your city, in the spring of 1895, stated that the opposition telephone company with which he was connected owned or controlled patents that would give that company a more exclusive monopoly of the telephone business than the Bell enjoys. And it was principally on this statement that we invested our money in a telephone exchange.

It is doubtful if many of your readers realize how large an investment will be practically wiped out if the United States fails to win this suit. For during the past two years opposition telephone exchanges have been established—representing an investment of several millions—in more than 100 towns or cities. In many of these exchanges the mere closing of the plant in compliance with the decree of the court will not end the liability of the stockholder, and his only loss prove to be the amount originally invested, for many of these exchanges are not yet in operation, have no income, and have a large indebtedness to meet. Take Jersey City, for instance, or Newark, where the public-spirited citizens have already probably invested more than $100,000 in the stock of the local company, and yet the work of construction has hardly begun. And while a few telephones are connected in service, yet the agreement is that until (500?) a stated number are operating satisfactorily, no rental will be collected, and hence it is now all outgo and no income, and must so continue for some weeks.

Elizabeth and Trenton have opposition exchanges, and Montclair, Paterson, Cranford, and other towns are trying to get under way.

GEORGE SLAXZON.

Jersey City, November 9.

The statement made by Mr. Slaxzon in his letter on the telephone question is really most amusing. Would he have your readers infer that the United States Government has employed ex-Solicitor-General Aldrich for no other purpose than to destroy one monopoly that another may thrive? Yet that is the natural and the only inference we can draw if Mr. Aldrich's company really owns or controls "patents that would give that company a more exclusive monopoly of the telephone business than the Bell enjoys." I do not believe the United States officials are engaged in that kind of a scheme, while I do believe that if the Berliner and Edison patents are declared invalid it will not materially change the present policy of the Bell companies. But the cancellation of the patents will afford an excellent opportunity for adventurers to inveigh unsuspecting and inexperienced investors into attempting to establish competing telephone exchanges in our larger cities, where, in the very nature of the service, the telephone exchange must ever remain a natural monopoly, and two or more exchanges prove a burden that the progressive merchants must endure and support. We now have two telephone companies in Trenton, and a third is getting under way.

When a new telephone company attempts to secure a foothold in a large city, it finds that one of the great problems it must solve lies, not in the total number of subscribers it can secure, but in the number of desirable subscribers that will prove permanent and paying patrons. For the service of a telephone exchange increases in value in the same ratio as the names of the desirable elements in the community are added to its list of subscribers. In other words, while a newspaper circulating only among saloons and read principally by the frequenters of such places might prove profitable to a certain class of advertisers, the general advertiser would not use its columns, as it would not reach the public in general—the buying classes. So a telephone exchange might secure several hundred or a thousand or two subscribers, and yet the combinations afforded have no practical value to the constant user of telephone service or the general public, and the secured subscribers be rarely called for. But the progressive merchant must pay his tribute to each company just the same. Thus it is not only the greatest number of people you can reach with the aid of the telephone, but the greatest number of the very people you desire to reach that renders telephone service invaluable.

A second problem, and one not so difficult of solution as that of securing the necessary desirable subscribers, is to secure the capital necessary to construct a modern telephone plant. Such a plant cannot be properly constructed for less than from $95 a subscriber to $175 a subscriber, depending on the size of the exchange; the larger the plant the higher the average cost per subscriber. A first-class telephone plant having a switchboard capacity of 1,000 subscribers can be completed for $125,000, while it would probably require an investment of $500,000 to complete every detail in a modern plant of 3,000 subscribers. Many opposition telephone exchanges have been built for a less sum per subscriber, notably Topeka, Kan.; Fort Smith, Ark.; Selma, Ala.; Waukesha, Wis.; and some twenty others. But these exchanges no longer exist, having gone the way of all purely speculative enterprises and leaving no return for the heavy investment. Now the shrewd financier is not putting his money into investments that promise as fat pluckings for promoter and lawyer as competing telephone exchanges do. He may loan the use of his name in return for a profitable consideration. But the plant will be built (well or poorly) from the investments made by "lambs"—honest and unsuspecting creatures who are so inexperienced as to believe that because a certain prominent citizen holds quite a block of stock in a new enterprise he must have invested a large amount therein. And as the "lamb" seldom has the reserve capital necessary to protect an investment of this character, he soon has a practical illustration of how easily his venture may be swallowed up and lost for ever.

But the most difficult problem that confronts the new company in a large city is to so plan the constructive and engineering features of a plant as to insure from the start a satisfactory high-class service to subscribers already educated to a high standard of telephone service. It means something more than placing a switchboard in a room and connecting thereto the wires radiating out to the subscribers' telephones. For the building of the modern telephone plant in a large city includes the planning or the construction of outlying exchanges connected to each other and also to the main exchange by underground trunk lines; and in the proper arrangement and disposition of these trunk lines, and the rapid handling of the ever-increasing traffic in conversations, abides an engineering problem, requiring capacity, ability and experience of the highest order to satisfactorily solve and thereby evolve a successful modern telephone plant.

JOHN WALTON BOURKE.

Trenton, N. J., November 11.

THE PACIFIC CABLE COMMISSION.

In pursuance of the summons issued last month, the Pacific Cable Commission met at the Colonial Office, in London, on November 9. The meeting was presided over by Lord Selborne, and was attended by the Canadian representatives to the conference, Sir Donald A. Smith and Mr. Jones. Sir Saul Samuel, Agent General in England for New South Wales; the Hon. Duncan Gillies, Agent General in London for Victoria, and Mr. George H. Murray, one of the principal clerks in the Treasury, were also present.

The meeting was merely for the purpose of organization. Secretary Mercer has arranged the lines of business to be pursued by the commission. It was announced that the commission would hold frequent meetings and make its report at the end of the year.

LETTERS TO THE EDITOR.

WATSON PATENT EXPIRED.

In the United States Circuit Court here to-day a motion was made by the attorneys, R. H. Parkman and S. S. Stout, of the Western Telephone Construction Company, to the effect that the Watson patent, No. 270,522, owned by the Bell Company, and covering all forms of telephone hook switches, had expired on July 30, 1895, by virtue of the expiration of a Canadian patent to Watson covering identically the same invention; an order was entered accordingly.

The discovery of this patent will be a great surprise to the electrical fraternity in general, and has killed one of the greatest bugbears with which competing telephone concerns have had to cope.

The Western Telephone Construction Co. were put to great expense to defeat this patent, and their efforts will not only secure them and their customers against interference from it, but open up the use of the telephone hook switch to the public. The immediate dismissal of suits brought against others will probably result. Another good Bell patent gone!

JAMES E. KEELYN,

President Western Telephone Construction Company.

Chicago, November 7, 1896.

THE TELEGRAPH IN ABYSSINIA.—**A Brussels firm is about to equip Abyssinia with a telegraph system, the more important stations to be connected with the imperial residence. Menelek proposes to be an up-to-date monarch.**

Electric Lighting.

A SINGLE COMMUTATOR THREE-WIRE GENERATOR.

AMONG the numerous excellent exhibits of dynamo electric machinery recently shown at the Berlin Industrial Exhibition is a machine built by the Electricitäts Actien Gesellschaft, formerly W. Lahmeyer & Company. This machine is remarkable in that it is designed to furnish current for a three-wire system of conductors, with a single armature, and commutator. In outward appearance the machine differs very little

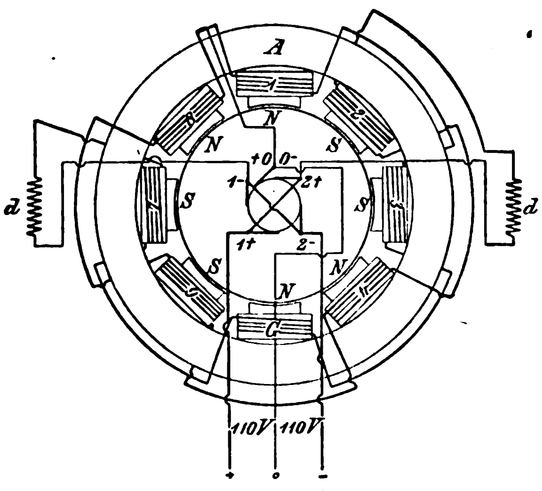
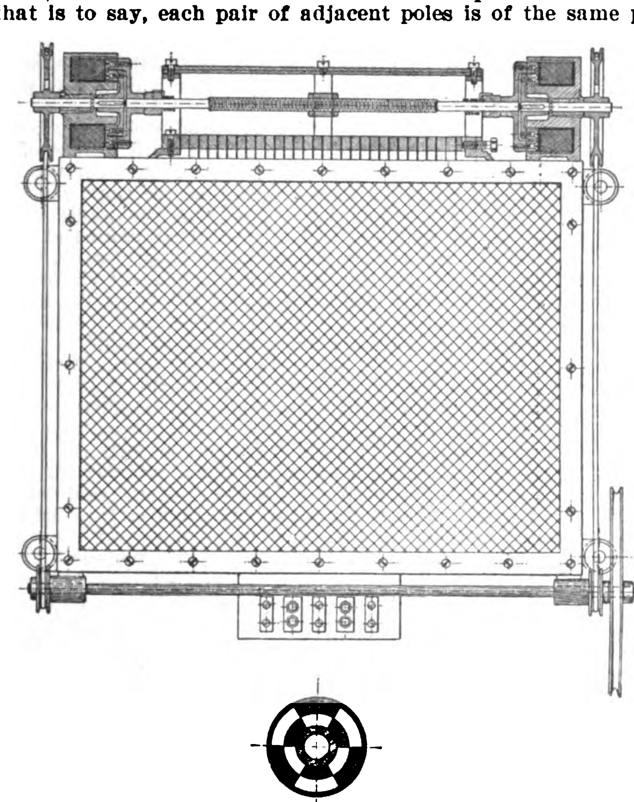


FIG. 1.—LAHMEYER DYNAMO FOR 3-WIRE CIRCUITS.

from the ordinary multipolar type, but the arrangement of its circuits is of considerable interest.

As shown in the accompanying engraving, Fig. 1, for which we are indebted to the "Elektrot. Ztsch.," the machine has eight poles, which are so wound that four double poles are created; that is to say, each pair of adjacent poles is of the same polarity. Within this field revolves a simple drum armature, wound for four poles. The four brushes, connected in pairs, 1—, 2—, and 1+, 2+, take off current at 220 volts, and a fifth brush bears between the brushes, 1— and 2+. This brush serves the purpose of dividing the potential, and in its relation to the other pair of brushes has a potential equal to zero.



FIGS. 2. AND 3. -LAHMEYER AUTOMATIC RHEOSTAT.

The magnet spools are excited in groups of four in series at 110 volts; that is to say, poles 1, 3, 5 and 7, and 2, 4, 6 and 8 are in series, respectively. Those magnet coils that excite the branch +0 are connected to the binding posts of the branch, and vice versa, so that the two branches excite each other mutually, by which means a better regulation is effected. Each branch can be regulated independently of the other, and the difference in load of the two sides of the three-wire system may be quite considerable.

The total weight of the machine is 7,500 kilogrammes, of which 1,900 are due to the magnetic system, 450 kilogrammes to the armature core and 450 kilogrammes to the winding.

The regulation of the machine is effected by two automatic rheostats operated by a small electric motor. This automatic regulator is of the usual type of sliding contact, operated by screw and nut, but instead of employing conical friction wheels as heretofore, the motion is transmitted from the driving spindle to the contact-shifting spindle by means of a pair of magnetic clutches, as illustrated in Fig. 2. The spindles passing through each bell magnet, are each constantly driven in opposite directions by cords from the main driving pulley. Between the inner and the outer wall of the bell magnet there are three inner and three outer segments of iron, shown in Fig. 3. The inner segments are connected with a short spindle, which is constantly driven, whereas the outer segments are connected with the spindle which operates the sliding contact. It thus follows that when the bell magnet is excited its inner segments carry the outer ones along with them, thus shifting the rheostat contact. As the two magnetic spindles are driven in opposite directions, it follows that, depending upon which magnet is excited, the contact will be shifted one way or the other. The magnets are thrown into circuit by means of a contact voltmeter.

AN OHIO TOWN IN BUSINESS.

A dispatch from Springfield, Ohio, of November 9 says: "Bellefontaine, the local option town near here, which recently was compelled to let its police force go, owing to no funds, is now on the eve of having its light supply cut off. The electric light trustees have appealed to the Council for aid, stating that they must have at least $3,000 immediately or shut up the light plant. The trustees are so badly in debt now for fuel, etc., that they decline to take any further risk. In the meantime, the wrangle between the wets and drys goes on. The bitterest feeling prevails.

A CITY LIGHTING SCHEME FOR NEWARK, N. J.

Newark may soon strive to own an electric lighting plant. The question is now under consideration. It was first brought up by the suggestion that the city establish a lighting system for the Centre Market. It was shown that the cost of a dynamo and plant for the purpose would be an economy compared with the prices charged for lighting by the private corporations. Then it was urged that the city take charge of its own lighting. In 1893 it cost the city $164,000 and in 1895 $194,000. It is said that the cost this year will exceed $200,000. Experts say that if Newark owned the plant the cost would be reduced one-half, and the remainder could be used as interest on bonds and for a sinking fund for the principal of the debt to be incurred in the establishment of the municipal lighting system. The matter will be brought before the common Council, and it is expected that there will be vigorous opposition from the friends of private ownership of public necessities.

SALE OF JACKSONVILLE ELECTRIC LIGHT CO.'S PLANT.

The plant of the Jacksonville Electric Light Company has been sold at legal sale to Arthur T. Parker and H. C. Bullard, for themselves and as trustees, for $5,000.

This was the only bid received. The decree under which the sale was made required that all bidders make a deposit of $1,000 before bidding on the property, and that no bid should be taken for less than $5,000.

The bid was made by Arthur G. Hamlin, attorney for the purchasers, and there being no further bids, H. H. Buckman, special master, knocked down the property, which consists of the engines, boilers, dynamos, poles, wires, etc., to Mr. Hamlin, as attorney.

EBENSBURG, PA.—The Ebensburg Light and Power Company reports that it is in the market for a 100 horse-power boiler and an 800-light alternator.

ROENTGEN RAYS.

RECENT ROENTGEN RAY OBSERVATIONS.

BY THOMAS A. EDISON

THE following is a list of chemical crystals fluorescing to the Röntgen ray, in addition to the seventy-two already published by me[1]. The experiments covey every chemical substance sold commercially. Attention is called to the fact that the double salt of silver and sodium chloride fluoresces. Small quantities of this salt occur in dry plates. It is probable that the sensitiveness could be greatly increased by definite amounts being added: Diphenylamine sulphate; sodium anthranilate; uranium borate; silver and sodium chloride; platinum and ammonium cyanide; gold and sodium cyanide; platinum and potassium lithium cyanide; platinum and strontium cyanide; sodium naphthylamine sulphonate; uranium and calcium phosphate; zinc and potassium cyanide; zinc and copper cyanide; uranium oxychloride; platinum and calcium cyanide; platinum and cerium cyanide; platinum and potassium sodium cyanide; lead sulphocarbolate; ammonium mellitate; lead sulphocyanate; calcium silico fluoride; sodium sulphamilate; sodium sulpho carbolate; mercury urate; para quinoline sulphonic acid; caffein hydrochlorate; sodium para cresotate; sodium anisate; cinchonidine hydro-iodid; zinc and manganese chloride; ethyl and succinyl succinate; uranium and ammonium carbonate; acenaphtene; benzoates of lead, barium, mercury and silver; salicylates of cadmium, lead; lithium and sodium benzoate; barium benzene sulphate; potassium benzene disulphonate; potassium sulpho-benzoate; acid mono-iodo salicylate; bismuth and sodium benzoate; cinchonodin dihydro chromate; acid mono-chromo benzoic para; potash chromo salicylate.

None of the above are as sensitive as calcium tungstate, the selected crystals free from flaws being more sensitive than any of the double cyanides of platinum and other metals. Defective crystallization and impurities reduce the sensitiveness more than 50 per cent. Certain crystalline forme of calcium tungstate do not fluoresce at all.

The Röntgen ray powerfully changes the normal condition of vision. With strong tubes, one can easily see through the hand with the naked eye, when both are brought very close to the tube; moving objects are also seen plainly. For the first two or three seconds the eye perceives nothing, but by that time the ray has made some change in the eye and the sensitiveness is increased.

SOME NOTES ON ROENTGEN RAYS.

BY PROF. ELIHU THOMSON.

SOON after the publication of Prof. Röntgen's discovery it was pointed out by several observers that whenever Röntgen rays were given out in abundance the glass of the Crookes' tube was strongly fluorescent, and some went so far as to put forward the view that the rays had their origin in the fluorescence of the glass. When, however, it was found that bombarded platinum within the bulb was a more active source of rays than the bombarded walls of a tube,and permitted of focusing the rays, this view had to be abandoned. But even when the tube is arranged so as to bombard a platinum piece by cathode rays concentrated thereon by a concave cathode terminal the fluorescence of the glass is still produced, but far more evenly than in the other case, while the fluorescence in a good tube is confined to those parts of the glass walls only where exposed to radiation from the bombarded spot on the platinum.

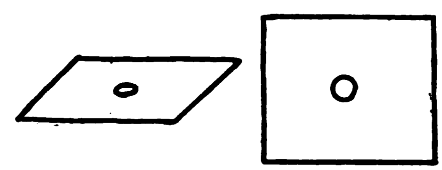
In other words, there is a dividing plane coincident with the plane of the platinum sheet and all the glass of the tube on the side toward the cathode is rendered fluorescent, while on the other side it is dark. Not only is this sharp division noticed, but the fluorescence is remarkably uniform and equally bright on the portion of the glass walls which are at equal distances from the spot on the platinum plate on the active side. This indicates that the intensity of the radiation, causing fluorescence from the platinum plate is sensibly the same, whether the rays emanate normally or at any angle, even to the direction of almost coincidence with the plane of the plate.

The use of a fluorescent screen or of photographic plates shows that the Röntgen ray emanation is sensibly as intense at all angles from the bombarded spot on a true plane of platinum, while, of course, the focusing effect is more sharp when the rays are used that leave the platinum at high angles, to the normal, or nearly in the plane of the sheet. This is, of course, due to the fact that, viewed edgewise (see the figure), the spot becomes almost a line of a length equal to the diameter of the spot.

This fact may be taken advantage of when extremely sharp focusing in any particular direction is required.

The above considerations lead at once to the conclusion that the fluorescence of the glass is in reality caused by and is an index of the intensity and distribution of the Röntgen ray emanation. There is still left the question as to whether, when the glass is bombarded by the cathode rays, such fluorescence as is produced is a direct result of cathode ray bombardment, or arises in turn from the Röntgen rays, which are a result of such bombardment. When a spot on the glass wall of a Crookes' tube is bombarded it will be found that sparks sometimes ⅛ inch long, can be obtained from the outer surface at the bombarded spot, and that if a terminal of a small Geissler tube be presented to the spot while the other terminals touch the hand, the Geissler tube is feebly lighted. Around the spot is a comparatively neutral zone, and beyond that a feeble effect can be obtained all over the glass wall at a proper distance from the terminals. Recent observations show a change in polarity, the spot bombarded being made negative at each discharge, while the other parts are positive, a neutral zone existing between them.

To test the question, or, rather, to illustrate the action of the Röntgen rays in causing fluorescence of the glass, some of the same glass was finely powdered, mixed with varnish and made into a screen instead of tungstate or platino-cyanide. It was found to give a feeble result, but sufficiently strong to allow the shadows of the bones in the fingers to be seen. From the fact that the fluorescence on the glass of a strongly active tube can be seen even in a room lighted by daylight, it would seem that the radiation which reaches the glass screen must have lost enormously in passing the glass wall of the tube. This follows from the feeble effect on the powdered glass screen, for we know that the glass wall is too thin to absorb the Röntgen radiation to an extent more than a moderate percentage of the total.



AN X-RAY EFFECT.

May it not be that the rays which are produced at the bombarded surface of the platinum are mixed with others of a lower wave length, which, while they can excite fluorescence of the glass to an equal or even greater degree than can the Röntgen rays, are absorbed or stopped by the glass wall, owing to its opacity for them? That such rays can exist and have this property has already been shown theoretically. Considering Röntgen rays as very high pitch transverse vibrations (a view which the writer tentatively adopted from the first), the bombardment possibly gives rise to other rays too low in rate of vibration to penetrate such materials as could be used to form a Crookes' tube. This view is favored by the fact that fluorescence of the glass can often be produced at lower exhaustions without giving Röntgen rays, and at highest exhaustions the glass is less fluorescent, though Röntgen rays are abundantly produced, which rays, however, possess the property of penetrating bone as well as flesh, and which will even traverse considerable thickness of brass and other metals. Prof. S. P. Thompson was one of the first to point out this difference in the character of rays produced at the very highest exhaustions from those at lower exhaustions.

Considerable testimony has been given of late tending to show that Röntgen rays have a peculiar effect on the tissues, removing hair, causing blistering of the skin, deep-seated pain in the joints, etc. To test this the writer exposed the little finger of his left hand for half an hour to the radiation of a strongly excited tube (single focus). The back of the finger was placed almost in contact with the glass and only about one inch and a quarter from the bombarded platinum within. It was thought that an effect equal to four or five hours' exposure at ordinary distances might in this way be produced in half an hour. For several days after the exposure no noticeable effect was produced, and the matter was given no further thought, but at present writing, eleven days after the exposure, the skin of the back of the finger is red, swollen and painful to the touch, and the finger feels somewhat stiff. It has begun to blister. The effect resembles a strong sunburn. The palmar surface is unaffected as yet. It was quite a week

[1] See The Electrical Engineer March 25 and April 1, 1895.

before any definite effect was noticed. The unquestionable result produced leaves room for the hope that Röntgen rays may be found to have a therapeutic value, though, of course, it is as yet doubtful if they can be superior to ordinary violet light except in power of penetrating opaque bodies.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—VII.

BY LIEUT. B. A. FISKE, U. S. N.

RANGE INDICATING SYSTEM.

In the accompanying drawings, Fig. 23 is an electrical diagram illustrating the principle of the system, and showing one transmitting instrument T, and ten receiving instruments I, in circuit, each receiving instrument having an adjustable resistance in series with it, each adjustable resistance being in a metal box R. Fig. 24 shows in detail the mechanism by which in practice the contact C (Fig. 23) is moved along the resistance wire AB. Fig. 25 shows in detail the mechanism of the adjustable resistance inside of the box R, and Fig. 26 is a view of one of the receivers, or indicators, I (Fig. 23), with its resistance box R in position below it.

Referring first to Fig. 23, AB is part of a conducting circuit which includes the battery or other source of current, such as the electric light mains of a ship, connected through a suitable resistance, as shown in the cases of the helm indicator, steering telegraph and engine telegraph, in Figs. 1, 7, 10, and 11. T is a galvanometer which is connected in shunt with AB, one terminal being fixed at the point A, and the other terminal, or contact, C, being movable along the conductor AB. It will be clear that if the contact C is moved along the conductor AB, the difference of electric resistance, and, therefore, of electric potential or pressure between the points A and C will be varied, and consequently the extent of deflection of the needle or index of the galvanometer T may be controlled as desired, so as to cause said index to point to any scale-division or other mark or marks inscribed along its path. Connected in multiple arc with the galvanometer T are the two conductors + and —. Obviously these conductors will also be affected by the movement of the traveling contact C along the line AB, and will assume a difference in potential depending on the position of C on AB; so that if galvanometers I be connected to these conductors in the manner shown in Fig. 23, these galvanometers will respond to the movements of the contact C, for the same reason as does the galvanometer T. Furthermore, if all the galvanometers T and I be exactly similar, the needle deflections in all will be the same, and thus any indication caused in the galvanometer T will be repeated in the galvanometers I. Therefore, if T be the transmitting galvanometer, and if the instruments I be located at distant stations, it is plain that an operator at T, by adjusting the traveling contact S, can produce in his instrument a deflection which will instantly be repeated and shown at the distant stations in the receiving galvanometers I. It will be apparent, however, that if the galvanometers I are differently located with respect to each other and to the galvanometer T, so that in the circuit of one there is a different resistance from that which is in the circuit of the others, or if from any cause, such as rise in temperature, and consequent temporary loss of the magnet's strength, any galvanometer becomes less sensitive, means must be provided whereby said galvanometer may be adjusted or regulated so as to compensate for any such differences or changes, or, in other words, so that each receiving galvanometer may be so regulated that its deflections or indications will correspond to those of the transmitting galvanometer T. In the practical construction of the system these means are provided, and consist merely of an adjustable resistance placed in series with each galvanometer, and secured in a water-tight iron box R.

Turning now to Fig. 24, which shows in detail the means employed for moving the contact C along the wire AB, we see that the wire AB is wrapped in a spiral groove traced in an insulating cylinder D. The ends of the wire are secured to german silver springs, g, g, secured at the ends of the cylinder near the axis. The binding posts A and B are insulated from the metal box J, and their ends are prolonged about half an inch inside the box into cylindrical pins, or axles, a, a, which fit in the cylinder D, and press tight against the german silver springs, g, g, to which are secured the ends of the resistance wire AB. There is, therefore, a complete circuit from the binding post B to the german silver spring g, through the resistance wire that is wrapped around the cylinder, to the german silver spring g at the other end of the cylinder, and thence to the binding post A.

The cylinder is revolved on the axle AB by means of the handle H, which turns the screw S, and the gear wheel G, and thence the gear wheel G', which is secured to the cylinder D.

The contact C is secured to a stout piece of rubber that is secured on a nut N, that travels on the screw S. The pitch of the screw S and that of the spiral on the cylinder D are equal, so that, if the handle H be turned, the contact C will move with the nut N, though insulated from it, and press successively on different parts of the wire. The contact C is connected by the flexible wire W to the binding post C'. If the battery be connected to the binding posts AB, and if A and C be connected to the binding posts + and — of T in Fig. 23, it is clear that the act of revolving H will cause the same effect as

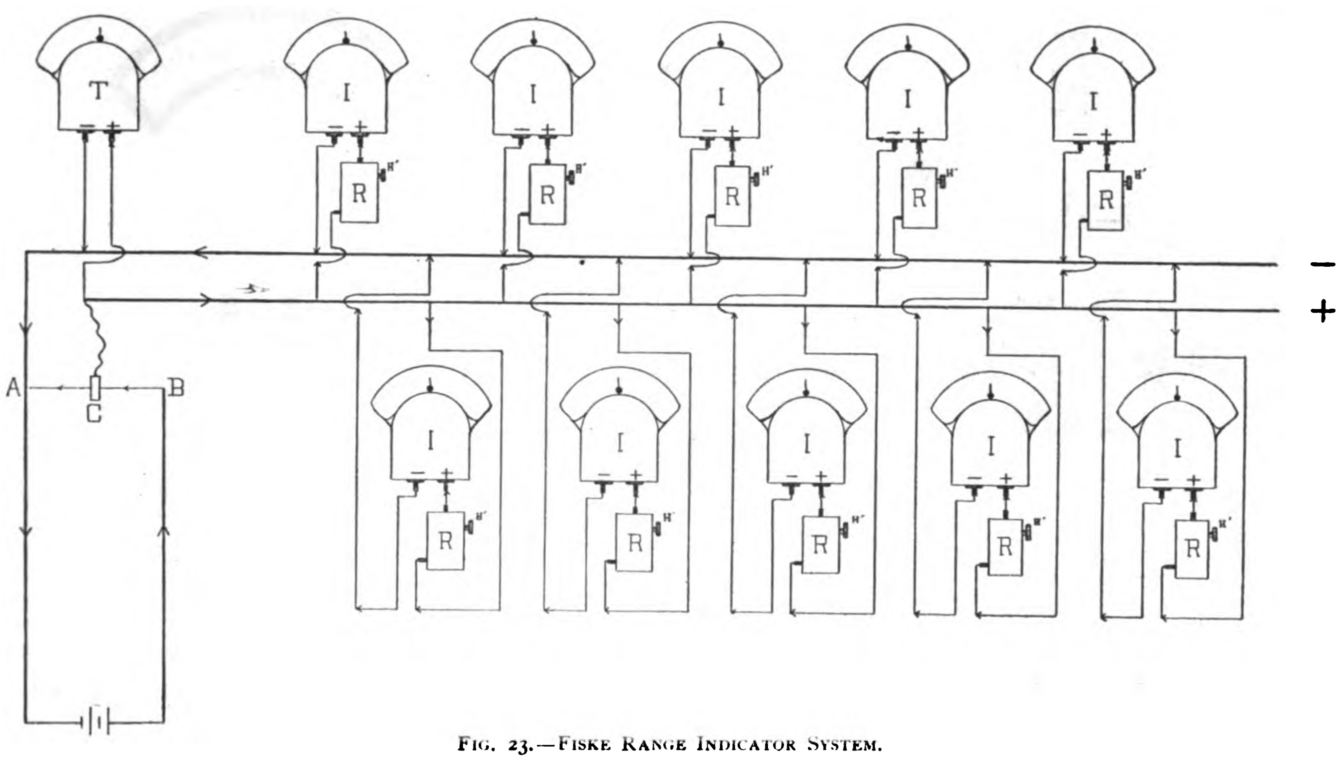


FIG. 23.—FISKE RANGE INDICATOR SYSTEM.

if the contact C were directly moved along the straight wire AB, in Fig. 23.

Turning now to Fig. 25 which represents the adjustable resistance in the box R, we see that the construction is nearly the same as that in the transmitting box just described. The resistance wire is, however, connected to the german silver spring at the center of its cylinder at the left end only, as the right end of the wire is secured to the insulating cylinder at the point P. The contact C'' is moved in the same way as is C in the transmitting box, Fig. 24, and is connected by the flexible cord W' to the binding post C'''. The current enters at the binding post A', passes thence to the german silver spring at the left end of the cylinder, to the resistance wire wrapped on the cylinder, to the contact C'', and thence to the binding post C'''. Clearly, if this apparatus be placed in series with any galvanometer I, and the handle H' be turned, the resistance in series with I will be varied and the deflection of I correspondingly changed.

The place for the transmitter T is near the reading instrument of the range-finder, so that any distance read from it can at once be made to appear on the transmitter and simultaneously on all the indicators in the ship.

To adjust the apparatus for use, connect the battery or other source of electricity and make the transmitter read, say, 29.50, or any other preconcerted number. Then make each receiver read the same number by turning the thumb wheel H'. The apparatus is now ready; but if there is time, it is best to try several preconcerted numbers in succession. It is better not to use the even hundreds in adjusting, because the graduations half-way between them are finer and give better opportunities for exactness.

The transmitting and indicating galvanometers are all similar, so that, in the event of accident to the transmitter, any receiver may be substituted for it. If this is done,, however, it will be necessary, of course, to verify the adjustment of the instruments, in the manner above described.

In case a battery is used, the one found most satisfactory for all this class of work is the "chloride" storage battery. It is extremely uniform in resistance and in electro-motive force, and requires almost no care, provided it be connected to the electric light circuit and charged once a week. To do this is very easy, as it only takes a little more trouble than is required to turn on an incandescent electric light.

The galvanometers can be secured directly to a bulkhead. If desired, they can be graduated to work in a horizontal position.

As far as giving accuracy of indications is concerned, the horizontal position is the best for a galvanometer, because the pivot of the needle is then vertical, so that the only friction possible is between the lower conical end of the pivot and the jewel in which it rests. From the circumstances of their use, the receivers must, as a rule, stand vertical; but there is no reason why the transmitters should not always be horizontal, both in service and when being graduated; and this is their proper position.

The later instruments are mounted in water-tight cases, and have the same construction as the instruments used in the helm indicator and steering-telegraph systems, illustrated in Figs. 6, 7 and 8.

Instead of being operated from a storage battery, as indicated in Fig. 23, the range-indicator circuit may be operated from the dynamo circuit, in the same manner as are the helm-indicator and steering-telegraph circuits; and the fact that the dynamo current is not uniform, but pulsating, is an advantage, because it gives the needles a minute vibration on their pivots, which is not sufficient to cause any difficulty in reading, but which prevents the needles from sticking.

The indicators should be so placed at the guns that they can easily be read by the gun captain, or other person charged with setting the sights, so that calling out by the voice will be avoided. A vertical position will, therefore, usually be best; and the indicators are graduated during manufacture while in that position. In case it is desired that one or more indicators shall lie horizontal, as may be the case in turrets, notice should be given in advance, in order that the indicators may be placed in that position during graduation. If the transmitter is placed below the protective deck, it should not, if it can be avoided, be put in a very hot place, because high heat diminishes temporarily the power of magnets, and this would render extra adjustment necessary on the transmitter.

The wires connecting the various instruments should have Navy standard insulation and be not less than No. 16 gauge. The mains should be laid, as far as possible, below the protective deck, with branches running up to each indicator, in order to minimize the chance of injury in battle.

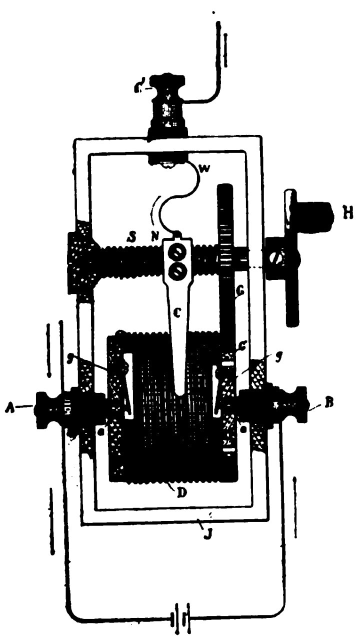


FIG. 24.

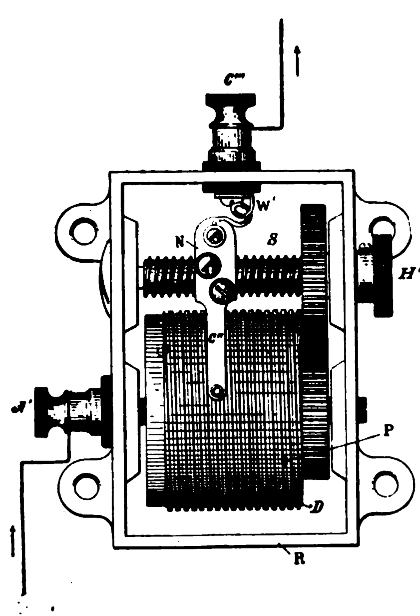


FIG. 25.

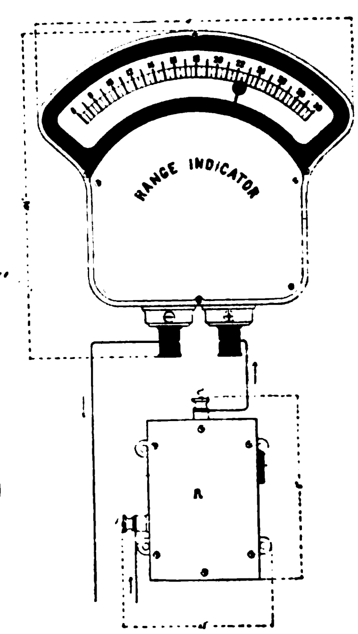


FIG. 26.

The rheostat which is placed in the dynamo circuit for cutting down the current of the range indicators, should be of the Carpenter form, in order to economize space, and should, when the e. m. f. of the dynamo is 80 volts, measure about 50 ohms; so that, with the 3.7 ohms resistance of the transmitter coils the current in the coil will be about one and one-half (1½) amperes. The rheostat should be capable, therefore, of carrying 1½ amperes without undue heating. It should be put in an accessible place in the dynamo room, where it can radiate heat readily, and for this reason should not be enclosed. Two separate wires are then to be run from the rheostat to the transmitter, so that the range indicator circuit will be independent of all parts of the lighting circuit, except in the dynamo itself.

PROTECTING THE HALIFAX FORTIFICATIONS.

The military authorities are laying cables for telephone connection between the various Halifax fortifications, which have heretofore been maintained by overhead wires. The headquarters station is in the citadel, and the cables radiate from that point. In connection with the military cable system each fort is to be equipped with a cable office, and men will be instructed and told off as operators.

WALKER & KEPLER, 531 Chestnut street, Philadelpha, have just finished the wiring in the new wing of the Aldine.

REPORTS OF COMPANIES.

THE ELECTRICAL MERCANTILE AGENCY.

CREDIT is the basis of all enterprises in modern commerce, and as a necessary consequence, it is a matter of vital importance that the financial soundness and responsibility of every concern buying material or issuing obligations should be thoroughly determined and clearly known. Such work as establishing the proper rating of the personnel of any trade or industry is at once delicate and difficult, but when well done, it amounts literally to the insurance or underwriting of one's business, if care is taken to observe the cautionary hints that come from the rating bureau. The electrical trade has long been in need of a sizing up of this character, and never more so than at the present moment, when the passing away of bad times is likely to invite that undue expansion of indebtedness which is in itself a menace to continued prosperity. Efforts have been made before the present time to render the resources of financial information in the electrical field specifically available, but it is not until now that the results can be spoken of as satisfactory. The general commercial agencies have therefore been depended on hitherto, but as other trades have grown and have at last demanded their own, separate data, handled by experts in each branch, so the electrical industry has reached the same point.

We are glad to call the attention of our readers to the work of the Electrical Mercantile Agency, of 318 Broadway, which has lately been founded by Mr. P. M. Mowrey, and is now in full swing. It aims at several important objects, which the general manager's training should well qualify him to achieve. Mr. Mowrey at one time had charge of the credits of the New York Edison Company, when it was a supply licensee for General Electric apparatus, and was subsequently treasurer of the New York Electric Equipment Company, thus acquiring an intimate experience for ten years with credit work. His staff is also well selected, and is in direct touch with over 6,000 correspondents throughout the country.

To begin with, by work extending over the past two years, the Electrical Mercantile Agency has sifted and classified the credits of between 12,000 and 15,000 concerns of all kinds that are in one way or another within the electrical field. These ratings are given in the Agency's "Credit Reference Book," a handsome, well-printed volume, to which is furnished a double key; one, alphabetical, quoting the estimated worth, and the other, numerical, giving the credit status. This book of over 300 pages, is renewed twice a year, and a correction circular is issued every week, giving brief news of judgments, mortgages, transfers, etc. The volumes come out in April and October, so as to secure promptly the changes which are likely to occur at the beginning or middle of the year, and which could not get into a book out on January 1 or July 1. The service of the Agency is rendered at the annual fee of $125, which includes all the literature above-mentioned, and 100 special confidential reports on any concern in any line, although, of course, the special business to which attention is devoted is electrical. Extra reports are furnished at $1 each. The Agency introduces a novelty also in this class of work, by furnishing special reports, of its own volition, if any conditions seem to demand it. Through its wide and responsible ramifications, the Agency also undertakes a collection business.

It will be seen that the new departure of the Electrical Mercantile Agency is one whose importance to the electrical trade cannot be exaggerated. It has been a reproach to this trade that the average of credit is extremely low, the rapid advance of the art having drawn in far too many adventurers and over-sanguine dealers. But even if the number in this class were larger, there is now no reason why its unreliability should play any part. All that is necessary is to know its ratings and get the Agency report on its credits. The sound and honest merchant has only a hearty welcome for such safeguards.

THE NILES, MICH. MUNICIPAL PLANT IN TROUBLE.

A special dispatch from Niles of November 9 says: "It is possible that some of the city's creditors may seize the electric works and city lighting plant. The outstanding debt is nearly $240,000, and the council finds itself unable to pay bonds long since due and held by N. W. Harris & Co., of Chicago. The treasury is empty and the taxes are not due until December. Last June the taxpayers voted down a special assessment and the prospects are that they would do so again."

FINANCIAL.

AN INCREASE OF SOUTHERN NEW ENGLAND TELEPHONE STOCK.

A call is to be issued immediately to stockholders of the Southern New England Telephone Company, meeting Nov. 17, to vote upon the question of authorizing the company to increase its capital stock from $2,000,000 to $3,000,000. The plan of the company, however, is to issue to stockholders at $90 the new shares of $100 each in the ratio of one to three of the 16,750 shares representing $1,675,000 of capital stock now outstanding, thus increasng the capital stock to $2,233,-300. The company will use the proceeds of the new stock in retiring next February its convertible five per cent. debentures amounting to between $300,000 and $400,000 and in extending and improving its plant. The returns for ten months of the present fiscal year indicate that the company is earning about 10 per cent. a year upon its outstanding stock. The ten dollars conceded to subscribers to the new stock is treated by the company as a distribution of surplus, and at the existing market price would make "rights" worth a little more than $3 each.

LEGAL NOTES.

A TROLLEY PARALLEL PERMANENTLY ENJOINED IN CONNECTICUT.

The text of the important decision given on Nov. 10 by Judge G. W. Wheeler, in the Superior Court, New Haven, Conn., granting a permanent injunction against the Hartford and New Britain trolley parallel of the New Haven Steam Railroad Company lines, shows that the decision does not turn directly on the question of public necessity and convenience, but on three points: First, that the trolley line layout occupies an appreciable part of the public highway, thus bringing the case within the general street railroad law; second, that its route exceeds the powers conferred by the charters of the three construction companies; and, third, that under the law the steam company is a valid party to the suit. The finding of facts, however, upon which the injunction is granted indicates clearly that Judge Wheeler is of opinion that public convenience and necessity do not justify the parallel. That finding emphasizes the former decision of Judge F. B. Hall against the necessity and convenience of a parallel, refers to the fact that the layout is on a line where there are few houses, and that the real motive to its construction is the obtaining of a direct competing line between the two cities. The decision is extremely prejudicial to the interests of the many projected trolley parallels in the State, indicating that the courts will insist on very strict construction of charters and upon strong proof of public necessity and convenience before competing trolley parallels will be authorized. This result of the long and bitter two years' contest also forecasts another session of the Legislature to be marked by sharp controversies of the electric and steam railroad interests. The Hartford-New Britain case will probably be among them.

RIGHTS OF TELEPHONE SUBSCRIBERS.—DECISION AT INDIANAPOLIS.

At Indianapolis, Ind., on Nov. 6, the State Supreme Court decided a case involving the right of a subscriber to have his telephone connected with that of another subscriber with whom he wishes to talk. August H. Fehring, a druggist at Columbus, Ind., and one of the subscribers of the Central Union Telephone Company, permitted a Dr. Hudson to use his telephone to call his horse from a neighboring livery stable after the doctor had had his own telephone taken out of his office because of some difficulty with the telephone company. The company objected to this, and finally refused to connect the drug store and livery stable until Mr. Fehring should assure them that he did not intend to let Dr. Hudson use his telephone. Mr. Fehring brought suit against the telephone company, under the statute which provides that every telephone company "shall within the local limits of such telephone company's business, supply all applicants for telephone connections and facilities with such connections and facilities without discrimination or partiality," and that its refusal to do so shall be punished by a forfeiture of $100.

The telephone company defended on the ground that they

had a contract with Mr. Fehring, binding him not to let others use his telephone, and also took the ground that the statute simply required the company to furnish an instrument to any one who requested it, but left it at liberty to establish regulations as to making connections between different instruments. But the court holds that under the provisions of the statute, telephone companies are not only required to furnish an applicant the instrument and properly connect it at the exchange, but it is also their duty to supply all the connections and facilities necessary to the use of the instrument. The opinion, by Judge Monks, says:

"Merely furnishing an applicant with an instrument and connecting the same with the exchange is not a compliance with the statute. This alone would not enable such person to use the telephone instrument. After the telephone instrument was furnished appellee and connected with it was the duty of appellant each time when requested by appellee to make such connection as would enable him to converse with the person named without discrimination or partiality, and for a failure to do so the appellant is liable to the appellee for the statutory penalty."

DECISION AGAINST CONTINUANCE OF WATSON TELEPHONE SWITCH PATENT.

A stipulation has been made by Judge Showalter in the U. S. Circuit Court, Chicago, in the case of the Western Electric Company against the Western Telephone Construction Company, which has been construed to mean that the monopoly as to the switch hook patent is terminated. The order concerned the Watson switch patent, which the Western Electric Company had contended did not expire until 1900. However, it was discovered that a prior patent had been taken out in Canada, and in consequence, by a previous ruling of the court, the patent expired July 30, 1895. This established the fact that the invention is now public property.

The Western Electric Company is not disposed, however, to believe that its business is hereby jeopardized. Speaking on the subject, George P. Barton, attorney for the company, said:

"The stipulation that was made in the United States Circuit Court was not of such far-reaching importance as has been claimed. It simply amounts to this, that the patent, which is known as the Watson switch patent, No. 270,522, expired on July 30,1895. The Western Telephone Construction Company or any other company or person is therefore free to employ the Watson invention, and, while we expect to gain damages for the infringement of the patent prior to its expiration, we cannot, of course, now obtain an injunction.

"But the Watson switch patent, although it was one of the more important patents on telephone apparatus, was not one of the controlling patents. It does not relate to the switchboard, but is the hook on which the receiver in the subscribers' telephone outfit is placed.

"It is evident that the expiration of a patent on an invention that is so small a part of the complicated telephone apparatus cannot bring about a revolution in the business by throwing it open to everyone who wishes to undertake telephone making."

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 110th meeting of the Institute will be held at 12 West Thirty-first street, New York City, on Wednesday, November 18, 1896, at 8 o'clock, p. m. A paper will be presented by Mr. H. Ward Leonard entitled "Volts vs. Ohms; Speed Regulation of Electric Motors." Complete working apparatus kindly furnished by the Crocker-Wheeler Electric Company, will be used to illustrate the practical operation of the system.

NEW YORK ELECTRICAL SOCIETY.

The 177th meeting of the New York Electrical Society will be held at Columbia College, Madison avenue and Forty-ninth street, on Thursday, Nov. 19, at 8 p. m. Mr. Joseph Sachs will deliver a lecture on "Horseless Carriages." The lecture will cover the general principles involved, and review the progress made in European developments as well as in those of this country. The leading details and features of the various forms of horseless carriages will be pointed out, and special attention will be drawn to the most recent and improved examples in the art, including machines propelled by steam, gas, oil and electricity. The lecture will be illustrated by stereopticon. Ladies are invited.

THE HENRY ELECTRICAL SOCIETY.

The Henry Electrical Society announces the following lectures for the next meeting: On November 20 Mr. Joseph Sachs will deliver a lecture on the present status of horseless carriages. The subject will be treated in a popular manner profusely illustrated by lantern slides.

On December 4 Prof. F. B. Crocker will explain the "Principles of Electro Chemistry." By the aid of experiments and the lantern the treatment will be rendered especially interesting and particularly valuable.

On December 18 Dr. L. H. Laudy will describe the different methods of "Lantern Projection," including searchlights.

ST. LOUIS ENGINEERS' CLUB DISCUSSES STREET LIGHTING.

At the last meeting of the Engineers' Club of St. Louis, Mr. M. L. Holman presented informally the proposed specifications and form of contract prepared by the Board of Public Improvements for the lighting of the streets, alleys and public places of the city of St. Louis for a term of twenty years beginning in 1900. The most important features of the proposed contract were the exclusive use of 32 candle-power incandescent lights in place of the arcs of 2,000 nominal candle-power, all wires to be underground. St. Louis was the first large city to adopt electric lighting on a large scale and has therefore had a very wide and valuable experience, arcs being used for the streets generally and incandescents for the alleys, parks, and also for a number of suburban streets. Valuable practical experience had therefore been had in the use of both kinds of lights, and the adoption of the incandescent light to the exclusion of the arc is the result of a careful investigation into the illumination given by the two systems. The duration of the contract was made twenty years in order that the city might secure reasonable bids.

Discussion followed by Messrs. R. E. McMath and B. H. Colby, who with Mr. Holman formed the sub-committee of the board which had this work in hand. They emphasized the fact that their conclusion was based upon actual observations made on the two systems of lighting in regular service in this city. The arc lights give a very unequal distribution, the illuminations being very intense at one point and there being but little light midway between. The incandescent lights, on the other hand, are placed much nearer together and afford a much more uniform light.

Further informal and general discussion followed in which Messrs. Robt. Moore, Eayrs, Crosby, Barth, Van Ornum, Ockerson, Pitzman, Wise and Philip Moore participated.

CHICAGO ELECTRICAL ASSOCIATION.

The association is doing good work this year. It announces as its paper for November 20. "Daily Problems in Long Distance Telephony," by E. L. Andrews.

AMERICAN STREET RAILWAY ASSOCIATION.

Secretary Penington is already inviting suggestions as to topics to be presented in papers and discussions at the next meeting of the association, to be held at Niagara Falls, N. Y., in October, 1897.

PERSONAL.

A PRESENT TO MR. F. M. PEDERSEN.

Dr. S. S. Wheeler, president of the Crocker-Wheeler Electric Company, presented Mr. F. M. Pedersen, the assistant engineer of the company, on Nov. 9, with a very handsome silver card receiver with the following inscription: "To Frederick Malling Pedersen. For distinguished services as Adjutant at Headquarters and in the Field, October 29th, 30th and 31st. 1896. From Schuyler S. Wheeler." In explanation it may be said that Mr. Pedersen had charge of arganizing and drilling the employés of the Crocker-Wheeler Electric Company, for the purpose of taking part in the great "Sound Money" Parade on the 31st of October, and it was in token of Dr. Wheeler's appreciation of the heartiness with which this work was entered into by Mr. Pedersen and the thoroughness with which it was carried out, that the above presentation was made. Dr. Wheeler is as enthusiastic on the sound money question as he is quick to recognize extra efforts of this character on the part of his associates. The marching of the Crocker-Wheeler regiment was magnificent, and aroused favorable comment all along the line.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Central Stations:

THE CENTRAL STATION AT NICE.—A detailed description of plant, with plans and elevations of the various sections of the building and a diagram of the distribution system. A 600-ampere-hour storage battery forms part of the outfit. "L'Ind. Elec.," Oct. 10, '96.

GAS ENGINES IN CENTRAL ELECTRIC STATIONS.—By R. Knocke. It is shown beyond a doubt that the block system of lighting in Germany is feasible, and the various calculations based on the value of gas to be 85 cents per 1,000 cubic feet. From Dingler's Polyt. Journ. in "Progr. Age," Oct. 15, '96.

Dynamos and Motors:

DESIGNING A BIPOLAR DRUM DYNAMO.—By Rankin Kennedy. Eight short rules giving the simplest arithmetical processes for designing an armature. Lond. "Elec. Rev.," Oct. 16, '96.

SUGGESTIONS FOR PROSPECTIVE PURCHASERS OF ELECTRICAL MACHINERY.—By Wm. Baxter, Jr. Author makes some valuable suggestions as to the relative sizes of engines and dynamos. "Western Elec.," Oct. 17, '96.

THE ALTERNATING MOTOR FOR FARM WORK.—By Robert E. Dallas. Author mentions a motor designed by J. J. Wood which has given good service on a farm, practically the only trouble mentioned being the heavy starting current. The time-saving element is quite an important factor. "Elec. Eng'r., Oct. 28, '96.

Electro-Physics:

FLUORESCENCE OF SODIUM AND POTASSIUM VAPORS.—E. Weidmann and G. C. Schmidt have been investigating the fluorescence of sodium and potassium vapor, and find that it is very marked, the sodium being green and the potassium red. The spectra which these vapors yield under the influence of electrical discharges appear to correspond to the fluorescence spectra, and it is pointed out that Stokes' rule holds for these as for other cases of fluorescence. It is suggested, in the conclusion of the paper, that the establishment of fluorescence for the vapors of the metals would throw light on some hitherto unexplained astrophysical phenomena. The original paper may be found in the "Annalen der Physik und Chemie," 1896 2), 57, 447. Note taken from Lond. "Elec. Rev.," Oct. 2, '96.

Isolated Plants:

ELECTRICITY AT ST. ELIZABETH'S U. S. HOSPITAL FOR THE INSANE.—A full description of a plant laid out without regard to expense, but with the intention of producing the most perfect installation obtainable. Six thousand lights have been installed and motor power will be employed for many purposes. "Elec. Eng'r.," Nov. 4, '96.

TEST OF AN ISOLATED ELECTRIC LIGHTING PLANT RUN BY A GAS ENGINE.—By S. A. Beyland. From a consideration of the figures and diagrams it may be seen that where only a small number of lights is required gas used directly is much cheaper. Above 30 lamps it is decidedly cheaper to use the gas for fuel in driving the dynamos. "Progr. Age," Oct. 15, '96.

Lighting:

ELECTRIC CAR LIGHTING.—A system patented by Morris Moskowitz, in which a dynamo is run from the car axle and which has an automatic speed regulator; current does not commence to be generated until a speed of eight miles is reached; storage batteries are used to supply current when the cars are not in motion. Plans and elevation accompany the descriptive matter in "Railroad Gaz.," Oct. 31, '96.

ELECTRIC LIGHTING AT THE NATIONAL EXPOSITION AT GENEVA.—By R. B. Ritter. The first of a series of articles. Both arc and incandescent lamps are used, but the ordinary practice was not followed in every case; 240-volt lamps were tried, although not with very great success. The Alioth transformer, which transforms from a rotary into a direct current, also receives some mention. "L'Ind. Elec.," Oct. 10, '96.

Miscellaneous:

A GAS ENGINE DRIVEN ELECTRIC INSTALLATION.—The Empire Theatre (England) used to be supplied by the electric light company and found that by having their own gas engine plant, using corporation gas, a saving of $650 was effected in nine weeks. Lond. "Elec. Rev.," Oct. 2, '96.

REOSTENE, A NEW RESISTANCE METAL.—Dr. Harker, of Owen's College, Manchester, before the Brit. Assoc., described some experiments made by Mr. A. Davidson and himself on a new alloy for commercial electrical resistances, which has been called "reostene." This alloy is the outcome of a number of experiments made with a view to find a material of a higher specific resistance than iron, capable of carrying heavy currents, and having only a moderate temperature coefficient. Lond. "Elec. Rev.," Oct. 2, '96.

THE HOOKHAM ALTERNATING CURRENT METER.—A picture of the instrument, with a detailed description of the improvements which have been made on it during the past year. Lond. "Elec. Rev.," Oct. 9, '96.

Railways:

THE CITY OF ST. LOUIS AND ITS TRANSPORTATION SYSTEM.—Besides a general review of the railway development and general traffic, Mr. Richard McCulloch gives an account of the railway cars in St. Louis, and Mr. Winthrop Bartlett gives details with plans of the power stations in that city. Finally the roadbed is separately treated. "Str. R'y. Journ.," Oct., '96.

TRACK AND TRACK JOINTS.—By M. K. Bowen. Paper read before the St. Louis Street R'y Convention. Author discusses construction, maintenance and bonding. Prices of track construction and costs of maintenance are of especial interest. "Street R'y. Journ.," Nov., '96. "Elec. Eng'r.," Oct. 28, '96.

MODERN OVERHEAD CONSTRUCTION.—By Benj. Willard. Paper read before the St. Louis R'y Convention. Author enumerates various types of pole construction and gives prices, as well as their depreciations. "Str. R'y Journ.," Nov., '96. "Elec. Eng'r," Nov. 11, et seq.

DAILY INSPECTION AND CARE OF CAR EQUIPMENT.—By James B. Cahoon. Author explains in a short article how inspecting of cars is carried on in practice. "Elec. Age.," Oct. 24, '96.

A NEW ELECTRO PNEUMATIC BRAKE.—By Fr. Miron. Some modifications of the Westinghouse brake. "La Rev. Techn.," Oct. 10, 96.

STREET RAILWAY TRUCKS.—By J. N. Akarman. Paper read before the St. Louis R'y. Convention. Speaker dealt with the principles involved in the street railway truck, with the requirements for the service, and with the value of the single and double truck. "Elec. Eng'r.," Nov. 4, '96.

Roentgen Rays:

SOME RECENT ROENTGEN RAY WORK.—By Elihu Thomson. Author dwells on the value of the stereoscopic method of observation.—"Elec. World," Oct. 10, '96.

SEARCH FOR SOLAR X-RAYS ON PIKE'S PEAK.—By F. Cajori. Assuming the possibility of solar radiation to contain X-rays, the terrestrial atmosphere might possibly absorb them, hence experiments at very great heights were performed, but no evidence whatever of the presence of Röntgen rays was obtainable. "Am. Journ. of Science," Oct., '96.

Telephony, Telegraphy, etc:

ELECTRICAL DISTURBANCE IN SUBMARINE CABLES.—By W. H. Preece, F. R. S. Paper read before section A, of the British Assoc., Sept. 23, '96. Author points out the various disturbances, explaining a disturbance to be the result of the expenditure of energy in the wrong place. He explains the effects of electrostatic and electromagnetic induction, and then devotes his attention to telephone cables exclusively. Lond. "Elec. Rev.," Oct. 2, '96.

THE NEW WESTERN UNION TELEGRAPH OFFICE IN BUFFALO.—By A. C. Terry. One of the new types of office in which the motor dynamo takes the place of batteries. Detailed description, with illustrations, in "Elec. Eng'r.," Oct. 28, '96.

THE MODERN POWER HOUSE.—By Richard McCulloch. Paper read before the St. Louis Convention. Author gives some points on the selection of location, on the building, on the steam operating apparatus and steam consuming machinery. "Str. R'y. Journ.," Nov., '96. "Elec. Eng'r.," Nov. 4 and 11, '96.

THE ECONOMY OF THE ELECTRIC MOTOR.—The great advantage of the motor for crane work is pointed out and editorially it is remarked that the mechanical more than the electrical engineer urges their use. Lond. "Elec. Rev.," Oct. 16, '96.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

IMPROVED REGULATING MECHANISM FOR ARC LAMPS.

UP to within the past two years the operation of a clutch arc lamp on a constant potential circuit was considered impracticable. The invention of the enclosed arc method of illumination called for a lamp which would draw and maintain a long arc efficiently, and opened up a new field for the clutch lamp. The old-style lamps were replete with mechanism, consisting of a train work of wheels, rack rod and escapement movement; also adjustable parts subject to the influence of weighted levers, tension springs, etc. These complicated parts naturally required frequent adjustment and repairs.

In the "Pioneer" long burning arc lamp there is a bold departure from old methods. A glance at the accompanying cut will show that the rack work and clumsy mechanism have been superseded by a simple and effective clutch. The arc is sprung by a pair of solenoids which lift the armature

PIONEER ARC LAMP CLUTCH MECHANISM.

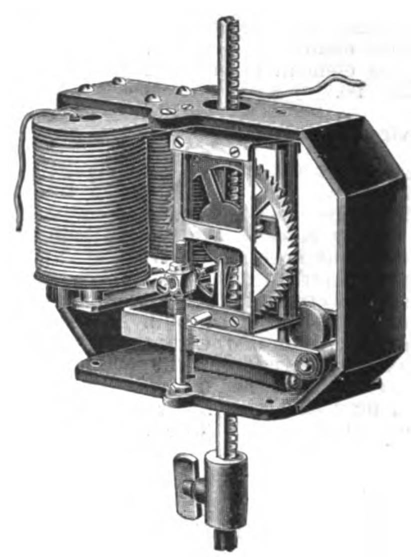
and lazy clutch and with them the carbon rod. The amount of iron in the moving parts is so proportioned that the current passed by the lamp is practically constant for any position of the armature. The lamp will pick and maintain an arc of about ⅝ of an inch in length. As the carbons waste away, the armature gradually descends until the clutch mechanism rests on the stops, as shown in the engraving. This releases the rod and allows the upper carbon to feed. The clutch is then instantly raised slightly from the stops. The feeding of the lamp is almost imperceptible and unattended by any flickering in the light.

It will be noted that there are no springs, wheels or other adjustable parts in the mechanism; hence there is nothing to get out of adjustment. When the carbon rod has reached the lower limit of its travel, the lamp is automatically cut out of circuit.

AJAX ARC LAMP MECHANISM.

THE lamp mechanism illustrated in the accompanying engraving is that of the new Ajax enclosed arc lamp for which many distinctive features of merit are claimed and which especially adapt it for lamps of the long burning type. Such lamps must not only be simple as regards the number of parts used in their makeup, but the few parts used must be of such a nature as to require the least possible care in operation; else one prominent feature of this type of lamp is forfeited and frequent inspection will largely take the place of short interval trimming, causing annoyance and a charge on the debit side of the ledger.

A rack feed was selected for the Ajax lamp because of the advantages possessed by this construction for lamps which are inspected and cleaned only at long and irregular intervals, which custom usually prevails where long burning lamps are used. The rack feed, of itself, is a simple and positive mechanism, but the usual train of gears has been avoided. There is no gearing used in the Ajax lamp except the one pinion which engages loosely the rack rod and supports the latter at a position determined by the strength of the series solenoid. By reference to the engraving it will be seen that there can be no slippage of the carbon rod and consequently no feeding of the upper carbon until the vertical vibrating pin is allowed to fall below the horizontal adjustable pin by the consumption of the carbons and the consequent lowering of the cores of the solenoid. This positive feed feature well qualifies it for locations where there is considerable vibration, such as in mills,



THE AJAX ARC LAMP MECHANISM.

where looms or heavy machinery cause a continual jarring, or steamboats, and in other unstable situations.

The absence of frictional clutches and other tight fitting parts eliminates the possibility of the carbons sticking, the "feed" being accomplished by inappreciable increments through the medium of gravity and a weighted escapement pawl which vibrates very slowly. The free working of the feeding mechanism is a very important item, for, as stated above, a lamp which is trimmed only at intervals of weeks should be designed to feed evenly throughout its entire run of 150 hours, whether the carbon rod be polished frequently or only kept approximately clean.

It is claimed that the simple and easy working mechanism of the Ajax lamp will appeal to that large class of producers of artificial light who look for efficient service from lamps which require only ordinary care.

The escapement pawl is case hardened, all steel parts are nickel plated and the entire absence of springs and dash pots are among the features which commend the Ajax lamp for durability and reliability.

Pomeroy, Woltmann & Co., of 43 Cortlandt street, New York, are manufacturers of this already popular lamp.

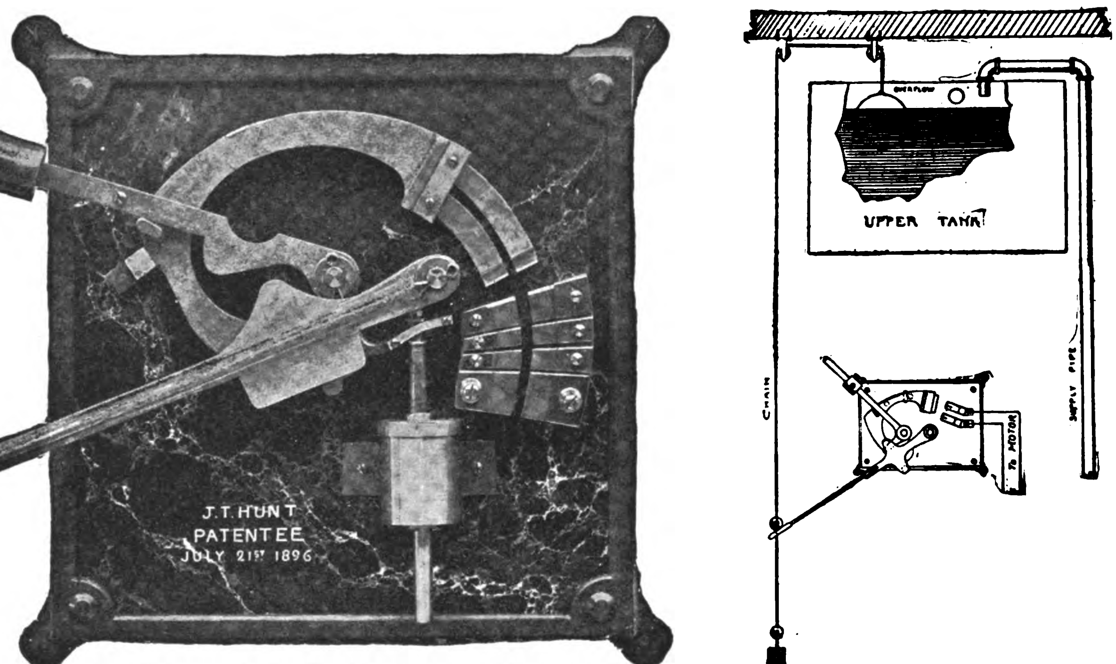
MR. LEWIS G. ROWAND, of the Universal Fire Alarm Company, 925 Chestnut street, Philadelphia, has received and printed a very complimentary letter from President Brown, of the Old Dominion Steamship Company, with regard to the quality of their work and apparatus. The Duplex boxes are well built, ingenious in principle and up to date in every detail.

ZIMDARS & HUNT AUTOMATIC SWITCH FOR STARTING MOTORS.

THERE are many situations in which power is required at irregular intervals and where the expense of an attendant to switch a motor in and out would be prohibitive. As an example we need only cite the many instances where water has to be pumped into a tank situated on the roof or some other elevated position. In such cases evidently an automatic switch is required. The most recent apparatus of this type are the automatic switches invented by Mr. J. T. Hunt, and manufactured by Messrs. Zimdars & Hunt, 127 Fifth avenue, New York.

Our engraving, Fig. 1, shows the switch designed for automatically starting and stopping motors up to and including 5 horse-power. Fig. 2 shows the same in position after cutting off current and stopping the motor, the water in the tank having reached the desired level. As the water level is lowered, the float in sinking raises the weight on the chain running through the slot in the bottom lever of the switch, until the lower adjusting ball reaches the lever.

In lifting, it gradually raises the top lever until it reaches a vertical position. The weight on this lever then carries it over by gravity, causing it to strike the cam and make contact and start the motor and pump. Any desired depth of water can be maintained in the tank by altering the distance between the adjusting balls on the chain running through the slot of the switch lever.



FIGS. 1 AND 2.—ZIMDARS & HUNT AUTOMATIC MOTOR SWITCH.

The switch illustrated in Fig. 1 is arranged so as to allow the current to enter gradually through a resistance, thus preventing undue sparking at the commutator. The switch thus takes the place of the starting box or rheostat usually operated by hand. As will be seen, an air cushion or dash pot is provided so that the switch can be readily adjusted to throw in the current over a period extending from five to thirty seconds.

These switches have been in practical operation for over five months. Among the locations in New York in which they are at work are the following: Equitable Gas Works, Fortieth street and East River; electric light plant at 45-49 Bleecker street; the Cook Apartment House, 117th street and St. Nicholas avenue; residence of Jas. C. Pyle, Fifty-third street and Fifth avenue; Hotel Logerot, Eighteenth street and Fifth avenue; Chas. Yandell, decorator, Eighteenth street and Fifth avenue; the Carrollton, Seventy-sixth street and Madison avenue, controlling a 5 horse-power Eddy motor.

The Broklyn Edison Company also has one of these switches at work in its Pearl street station, and Mr. Peabody, of the same company, has one in his residence. W. E. Quimby also uses these switches almost exclusively in connection with his electric pump work.

MR. EUGENE H. ABADIE, of the Wagner Electric Mfg. Company, St. Louis, was a visitor to Chicago a few days ago when his many friends were pleased to see him. The Wagner Company is marketing some admirable apparatus.

CREDIT FOR THE FIGHT AGAINST THE WATSON PATENT.

Great interest is being manifested everywhere in the recent surprise sprung upon the electrical public in the discovery of an old Canadian patent whose existence has invalidated the famous Watson switch patent, No. 270,522, regarded as one of the bulwarks of Bell telephone control of the situation. It is natural that there should be a desire to enjoy the credit for such a victory. We gather from the Standard Telephone and Electric Company, of Madison, Wis., that they are entitled to the glory and honor, and in support of their claims they send us the following copy of a very striking letter from Barton & Brown, well known as the legal representatives of Bell telephone and Western Electric interests in such matters. The letter runs as follows:

"Chicago, Ill., Nov. 3, 1896.

"Messrs. Morris & Morris, Attorneys Standard Telephone and Electric Company, Madison, Wis.

"Gents: Referring to the suit of the Western Electric Company vs. The Standard Telephone and Electric Company, of Madison, Wis., on patent No. 270,522, and the plea setting up Canadian patent for the same invention of July 30, 1880, we have to say that your plea was the first notice of any kind leading us to even suspect that there was a foreign patent which limited the terms of the United States patent. It was only yesterday that we saw a copy of the Canadian patent. It is, of course, a bar to the suit, and we shall accordingly direct that the suit be dismissed at complainant's cost.

(Signed.) "BARTON & BROWN."

The Standard Company are inclined to regard this as about as specific a proof of their right to the credit of the fight and victory as anything that could be produced.

GALE'S COMMUTATOR COMPOUND.

We illustrate in the accompanying engraving a most useful adjunct to every dynamo and motor tender. Any one who has had charge of a dynamo or motor knows well the tendency which they have to spark and cut at the commutator. The Gale's commutator compound, as shown in the cut, is convenient for use, will not gum the brushes, and, judging from the magnificent testimonials received by the K. McLennan Company, of the Marquette Building, Chicago, who are the sole manufacturers, it will absolutely prevent all sparking and prevent cutting. It is an easy thing to try, and as the McLennan Company will send a sample to all who request it, no superintendent should at least be ignorant of what it is.

MR. P. B. DELANY has located his city headquarters at Room 1011, Syndicate Building, Liberty and Nassau streets.

THE STANDARD TELEPHONE CO'S APPARATUS.

Special announcement will be found in our advertising pages from the Standard Telephone & Electric Company, of Madison, Wis., with regard to their apparatus for telephone exchanges and private installations. Among the exchanges enumerated are San Jose, Cal., 600; Portland, Ore., 1,500; Marquette, Mich., 600; Jacksonville, Fla., 700; Madison, Wis., 600. The Standard Company are the representatives in America of the excellent Milde microphone transmitters, which have been illustrated in The Electrical Engineer, and which are well known for their endurance and sensitiveness, having been awarded a great many prizes and medals. The company will be glad to send estimates for the complete equipment of exchanges, toll lines, etc.

A PROTEST FROM THE WALKER CO. AGAINST TRUST METHODS.

Since the publication in our columns last week of the news in reference to the proposition of the General Electric "Trust," seeking to exclude competitors, we have received a copy of a circular just issued by the Walker Manufacturing Company, of Cleveland, making a warm protest against such methods, and warning street railway companies against committing themselves in the way sought. The Walker Company renews its offer to protect any users of its apparatus, and says to its customers: "We address this circular to you so that you may be on your guard and avoid tying yourself to a combination which proposes to secure from you abnormal prices for electrical machinery in the near future." The Walker Company closes by asserting that this attempt is due to the large capital of the trust upon which dividends cannot be earned by fair competitive methods.

ADVERTISERS' HINTS.

MR. WILLIAM TAYLOR, 203 Broadway, New York, calls attention to a sale of 80 enclosed arc lamps, the sale being the result of installing 20 lamps on trial three months ago.

THE BERLIN IRON BRIDGE COMPANY illustrate a parabolic truss bridge designed and built by them at Waterbury, Conn. They contract for all sorts of structural iron work, corrugated iron roofing and fireproof shutters and doors.

THE AMERICAN BATTERY COMPANY, 40 W. Quincy street, Chicago, guarantee the uses of their storage cells against all infringement.

MR. MAX OSTERBERG, E. E., 27 Thames street, New York, is now the representative of the Correspondence School of Technology, Cleveland, Ohio, for Greater New York.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, remind the trade of the last eight years' record of the Packard lamp and claim they are to-day the most efficient and satisfactory lamps on the market.

"THE OTTO CYCLE GAS ENGINE" is the name of a new book by Wm. Norris, dealing with all the details of the subject. It may be obtained by addressing The Electrical Engineer.

McINTOSH, SEYMOUR & CO., Auburn, N. Y., call attention to their gridiron valve horizontal engines for direct connected service. They make this engine of any power, single cylinder, tandem or cross compound, vertical or horizontal and also various other kinds of engines.

NEW YORK NOTES.

MR. FRANK X. CICOTT. The Ansonia Brass & Copper Compnay, 19 and 21 Cliff street, New York, announces that it has secured the services of Mr. Cicott, who will represent its electrical and metal departments.

THE BUFFALO ELECTRICAL LABORATORY is starting as a branch of the Bliss School of Electricity, with rooms on the eighth floor of the Erie County Bank Building. Mr. Frank C. Perkins is the local manager.

THE CLONBROCK STEAM BOILER COMPANY are one of the companies who have not felt greatly the depression of the ante-election period. At the present time they have their staff at work busily engaged on orders ahead with encouraging prospects for good future business.

MR. J. I. AYER, of the American Electric Heating Corporation, Boston, was a visitor to New York last week, and spoke most hopefully of the outlook in the heating field. The company is pushing into a great many new territories and has to deal every day with new problems attendant upon the revolution it is effecting.

MR. H. P. COPELAND, for some time past with the house of The E. S. Greeley & Company, in charge of the catalogue department and the filling of orders, is now associated with James S. Barron & Company, of 147 West Broadway, in charge of their electrical supply department. Any supplies ordered from the Greeley catalogue will be promptly attended to.

STANLEY & PATTERSON, 32-34 Frankfort street, New York, issue copy of a letter from the Prudential Insurance Company, of America, signed by Mr. G. A. Warren, chief engineer, showing some remarkable results secured with 12 Fleming woven wire dynamo brushes which have been in use since February, 1894, on dynamos used 16½ hours daily. The brushes have worn down 1¼ inch, and the commutators show practically no wear.

MR EDWARD P. SHARP, of Buffalo, N. Y., who deals in new and second hand electrical apparatus and railway supplies, has issued his latest list of material on hand under date of November 12. The list includes almost everything necessary for the equipment of either a lighting or railway plant, and in addition to the price of each item is included a memorandum as to the condition in which the things are, which is of considerable importance to the purchaser.

NEW YORK STENCIL WORKS, 98-102 Nassau, New York, report business improving. They are having a brisk demand for name plates, of which they are extensive manufacturers. They sell largely to the electrical trade, and have such concerns on their books as the Edison Phonograph Works, Orange, N. J.; Western Electric Company, Interior Conduit and Insulation Company, and many others. This firm has been established since 1868. The New York Stencil Works manufacture other specialtes also, such as patent rubber telegraph wheels, steel letters and figures, steel dies, inks and materials, figure wheels, railroad seals, check protectors, brass labels. They do also die sinking and general engraving.

NEW ENGLAND NOTES.

MR. F. S. MINOTT, the general manager of the National India Rubber Company, was a New York visitor last week, stopping off in the city on his return to Bristol from the Sesqui-Centennial at Princeton.

MR. GERALD HART, president of the Hart & Hegeman Manufacturing Company, Hartford, Conn., paid a visit of a few days' duration to Chicago and made his headquarters at the Western office of the company, which is in charge of Mr. George S. Searing.

THE GENERAL ELECTRICAL ENGINEERING COMPANY, Tremont Building, Boston, Mass., is the name of a company recently organized as consulting and designing engineers. The officers of the company are E. W. Bailey, president; E. A. Bailey, treasurer, T. W. Byrne, manager.

CROWN WOVEN WIRE BRUSH COMPANY, of Salem, Mass., report an increasing demand for their brushes from all parts of the country. The Osburn Electric Supply Company, of Chicago, has taken the agency for Illinois; and the Michigan Electric Company, of Detroit, for Michigan. Both of these companies carry a large stock of the popular Crown brushes and can fill orders immediately.

MESSRS. WILLIAMS, COUCH & WHITMAN, Boston, Mass., have been appointed sole selling agents in the United States for the Ericsson Swedish microphone, and in this connection it is interesting to note that they have been compelled for want of room, to change their address to 196 Summer street, in which building both their office and factory are now located. The telephone business done by this firm in the past has been responsible for this change, and with these increased facilities the company are prepared to take good care of the imported microphone which they will handle.

WESTERN NOTES.

THE WESTERN ELECTRIC COMPANY, Chicago, report a very large demand for the Sunbeam lamps, especially for the 2, 4 and 6 c. p. lamps. Large orders have been filled for use in sign and decorative work.

O. K.—The manufacturers of the celebrated "O. K." weatherproof wire are placing on the market an elegant white underwriter's wire and also a very fine fire and weatherproof wire having an inner fireproof braid covered with an outer black weatherproof braid. The Electric Appliance Company are prepared to furnish these wires and are always glad to furnish samples and submit prices.

THE ARMORITE INTERIOR CONDUIT COMPANY, of Detroit, report that they are very well pleased with the amount of business they have done during the past few months, and also with the prospects for the future. Messrs. Austin and Cummings of this company are on the alert all the time, and are frequent visitors to Chicago, where they have done considerable work and are always heartily welcomed by their many friends.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. NOVEMBER 25, 1896. No. 447.

Electric Lighting.

THE NEW STATION OF THE SOUTHERN ELECTRIC LIGHT AND POWER CO., PHILADELPHIA, PA.

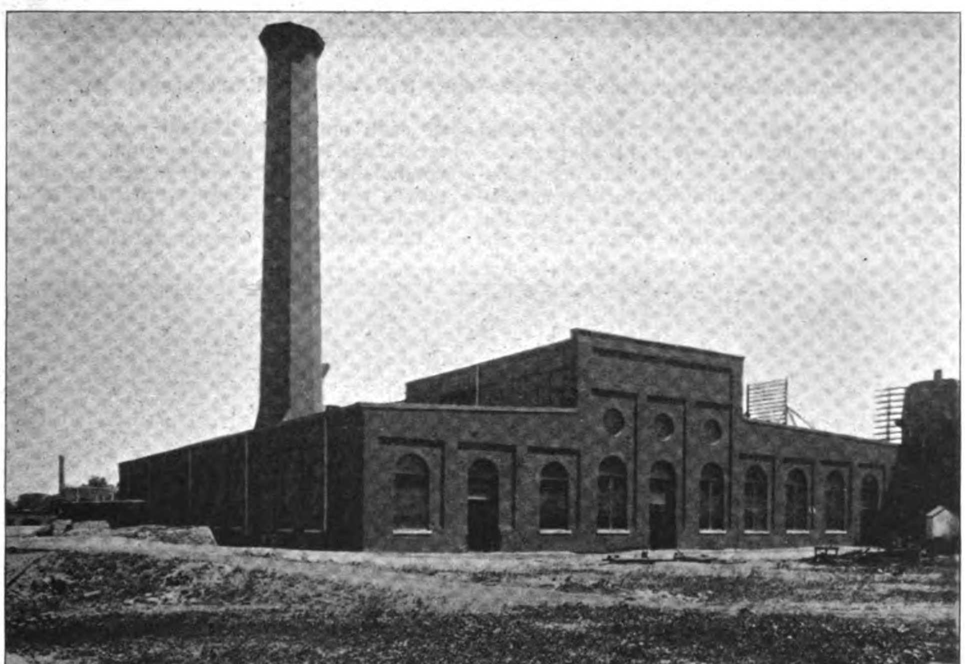
THE electric arc lighting service of Philadelphia is perhaps the most complete and extensive of any American city. Not only upon every main thoroughfare in the more closely built portions of the city and throughout the crowded sections, but upon avenues and the finely macadamized roads reaching far into the suburban sections, the most excellent service is maintained all night, and every night in the year.

The many lighting systems, together with the vast power plants required for the service, are owned and operated by private corporations, and the light is furnished to the city under contract. The stock of the companies is largely held by residents of the city and is widely distributed among all classes. The companies are a success from an investor's standpoint, largely due to the excellent business management for which they are noted.

One of the most prominent and progressive of these corporations is the Southern Electric Light and Power Company. The lighting service is furnished by this company for the most densely populated portion of the city lying south of South street, between the Delaware and Schuylkill Rivers. Until recently the company has owned and operated a number of plants, some of which they still hold for future use, should they be needed.

During the spring of 1895 they began the erection of the plant which is illustrated in the accompanying engravings. The site selected is a commanding position overlooking the Schuylkill River, with unlimited space for building and every natural advantage. With knowledge acquired by many years of experience in the service, the managers of the company started out with the determination to build the best lighting plant that could be designed. Competitive preliminary plans were submitted by leading engineers; those presented by Charles Edgerton, M. E., of Philadelphia, were selected, and the work proceeded at once under his personal supervision, while the architectural features were directed by John T. Windrim. Every part of the work, as it progressed, passed under the experienced eye and was pushed forward to completion by the indomitable energy of the managers of the company.

The plant, as built, is arranged for almost indefinite extension without alteration of the work already done. The buildings, including the immense smokestack, were erected by Messrs. Doyle & Doak, well known contractors, of Philadelphia. The main building is 204 feet in length by 174 feet in width, and the structure is steel throughout. The entire outer walls of the buildings and chimney are of selected stretcher brick laid in dark mortar. The general effect, while neat and pleasing, is massive and substantial, the structure plainly showing the purpose for which it was designed.



South Front of Main Building, Southern Electric Light & Power Co., Philadelphia, Pa.

One of the most difficult problems encountered by the engineers was that of water supply. It was found that, for condensing purposes, from six thousand to twelve thousand gallons per minute would be required, allowing for reasonable increase. To provide this, it was found needful to drive a tunnel some 1,300 feet through varying conditions of rock, quickstand, water gravel and river mud, to the bottom of the Schuylkill River. The work was promptly commenced and as promptly stopped by the contractor when the magnitude of the undertaking confronted him. A hurried consultation between the engineers and managers resulted in the work being undertaken at once by them. The necessary equipment was procured, competent men employed, and the tunnel completed.

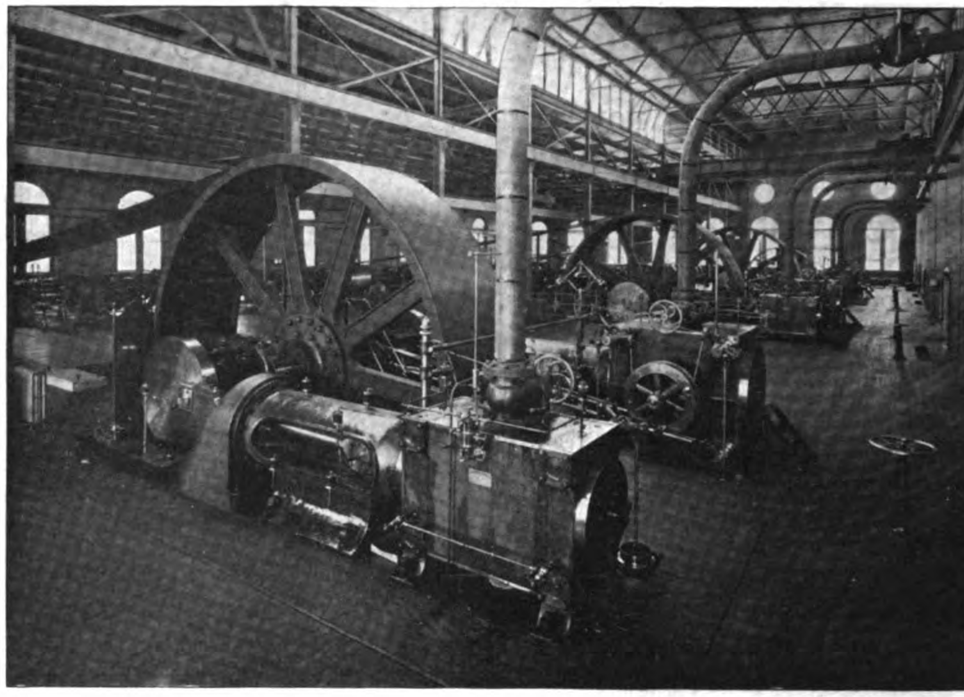
As the result, a circular conduit, 48 inches in diameter, inclosed by massive walls of brick, stone and cement, extends from the plant to the river, with ample provision for properly filtering the water before it enters the tunnel. Through this tunnel the water flows to the plant by gravity, and is taken by the condensers from a point immediately beneath them.

Probably the most striking features of the mechanical equipment of the plant are its remarkable simplicity, completeness and thorough interchangeability. Steam is supplied for the plant by twenty boilers of 150 horse-power each. They are of the horizontal return tubular type and have many novel features in construction and setting. They were built by the Coatesville Boiler Works and are made of Lukens' special firebox steel.

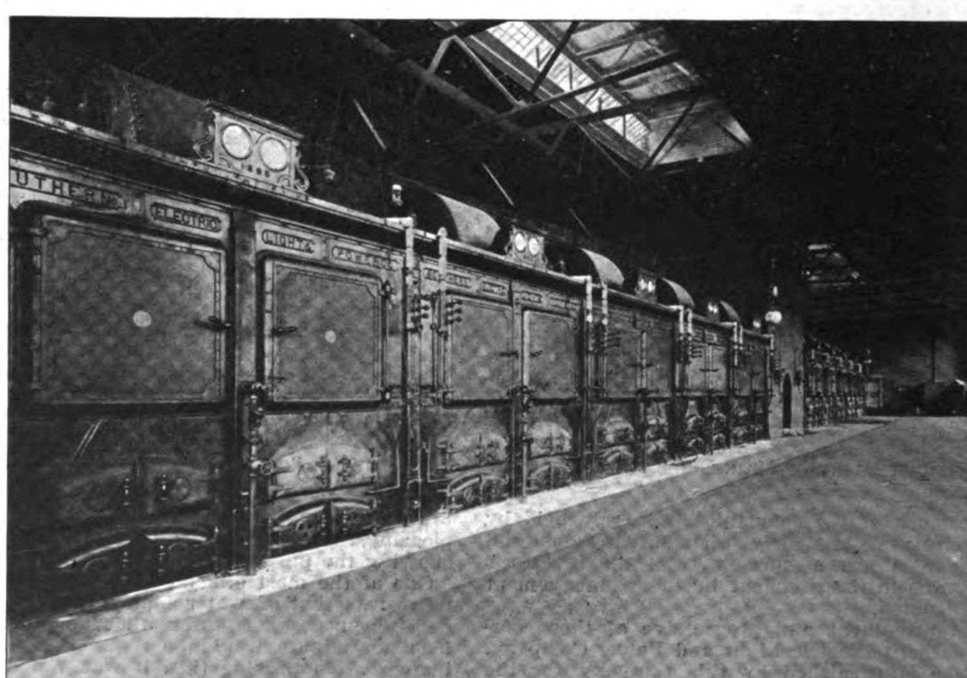
Four pairs of cross-compound engines of Corliss type, with a total capacity of 3,500 horse-power, drive the dynamos. The engines are of massive design and equipped with every modern device required for safety and close regulation. The weight of each engine is 230,000 pounds—the driving wheels alone weighing 70,000 pounds each. The engines when running condensing require but fifteen pounds of steam per horse-power per hour. They were built by the Hooven, Owens & Rentschler Company, of Hamilton, O.

The condensers were designed by Edwin Reynolds and built by the Edw. P. Allis Company, of Milwaukee, Wis. They are their regular type of jet condensers with special features required for the heavy service to which they are subjected.

The entire main systems of piping were constructed by



ENGINE ROOM, SOUTHERN ELECTRIC LIGHT & POWER CO., PHILADELPHIA, PA.

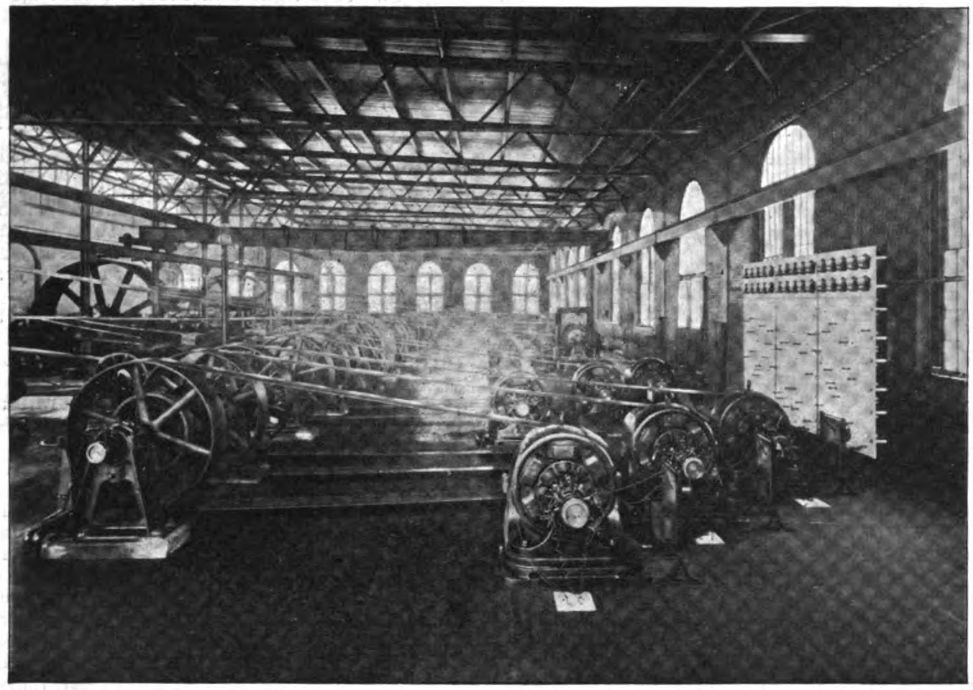


BOILER ROOM, SOUTHERN ELECTRIC LIGHT & POWER CO., PHILADELPHIA, PA.

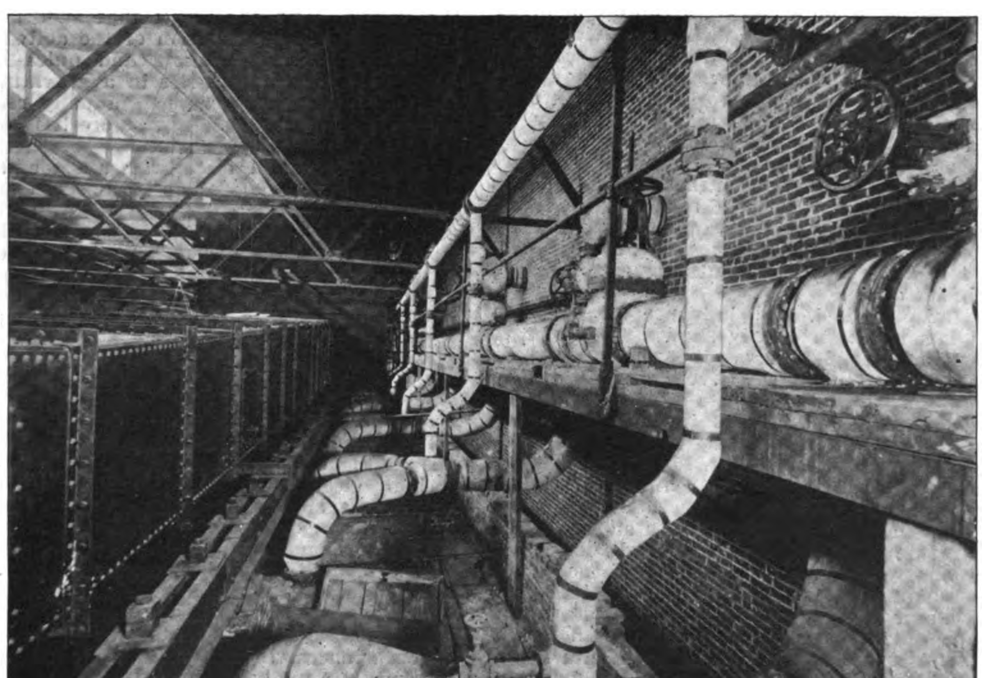
Messrs. Best, Fox & Co., of Pittsburg, Pa. The fittings of the high pressure system are steel forgings. The exhaust system is equipped with L. Schutte & Co.'s safety device for condensing systems. The pumps for water supply were furnished by the Snow Steam Pump Company, of Buffalo, N. Y. Two styles of feed water heaters are used, one in the vacuum system and one auxiliary. They were built by the Keystone Engine and Machine Company, of Philadelphia.

The system of power transmission embraces some novel features worthy of note. The driving belts are all of leather and were made by Charles A. Schieren & Co., of New York. The main belts are 64 inches wide by 164 feet long; the counter drives are of the same width, 93 feet long, all three-ply. To make the belts the hides of 2,305 heavy cattle were used, also 1,720 pounds of cement and three months' labor for twelve men. The belts weigh 13,700 pounds.

The shafting weighs 125,000 pounds. Each dynamo has an independent clutch and can be thrown on or off without interfering with any other machine. Any dynamo in the plant can be driven by any engine in the plant without the shafting carrying the weight of engine belts and pulleys not in use. This feature is accomplished by the use of hollow shafts or sleeves with main clutches for all engines. All clutches are of the Hill pattern. By an ingenious arrangement of the drives for counter shafting, loose lower belts on the dynamos are entirely avoided. There is not an idler nor a tightener in the plant. The shafting and attachments were built by the George V. Cresson Company, of Philadelphia.



DYNAMO ROOM, SOUTHERN ELECTRIC LIGHT & POWER CO., PHILADELPHIA, PA.



HIGH PRESSSURE MANIFOLD CONNECTIONS, SOUTHERN ELECTRIC LIGHT & POWER CO., PHILADELPHIA, PA.

The dynamos are of the Wood and Westinghouse types. The switchboard was built by the General Electric Company. In addition to the arc lighting service, the company is thoroughly well equipped for and is furnishing current for incandescent lighting and power purposes.

The officers of the company are the following: John M. Mack, president; James M. Mack, vice-president; W. J. Manning, treasurer and general manager, and Charles Edgerton, consulting engineer.

INSULATION.

BY PROF. W. M. STINE.

A RECENT editorial in The Electrical Engineer calls attention to the break-down in insulation, which is such a frequent source of loss and annoyance. It very clearly lays open what is perhaps the weakest point in electrical construction. Even a casual review of the subject suffices to show that great progress has been made since the early days, not only in the insulation of electrical machinery and apparatus, but of conductors and fittings; but great as this progress has been, the real advances have but fairly begun. Until recently, insulation has not received anything like scientific investigation, and, with the exception of a few manufacturers, only the crudest attempts have been made to improve the insulation by proper selection and careful working of material.

Recent papers by Mr. C. E. Skinner, and Messrs. Sever, Monell and Perry, give results of great value, and outline methods for testing, which, if carefully extended, would soon place us in possession of much useful data. Mr. C. P. Steinmetz has also made some excellent contributions to the subject.

Insulating materials exhibit three important properties, which influence their behavior under the applied stress of an electromotive force: (a) Insulation resistance; (b) disruptive strength; (c) hygroscopic qualities.

(a) All insulating substances, of whatever nature, may in general be regarded as conductors of extremely high resistance. For our present discussion we need not consider these substances as conductors by electrolytic separation, but rather as acting like extremely viscous liquids when subjected to stress; and thus temperature increase, by rendering them more viscid, will lower their insulating qualities.

(b) The power of insulating material to withstand disruptive discharges is really of more consequence than their insulating qualities. These substances may be considered to possess an elastic limit, with reference to the stress of an electromotive force, which, when exceeded, a rupture or break occurs. Important as are such tests, which show the influence of temperature on insulating power, they should be supplemented by tests which shall show their resistance to break-down throughout the range of working temperatures. This tendency to disruptive discharge may not inaptly be compared to the brittleness of hard substances.

(c) The hygroscopic quality of insulating materials refers to their tendency to absorb moisture from the atmosphere. As a consequence, their effective insulation is lowered, the increased conductivity being due to the moisture, rather than any change in the material itself. The leakage through this film of moisture is apt to char the insulating material and lead to complete break down.

In all tests, so far published, the influence of this hygroscopic element has not been clearly shown. In order to obtain satisfactory and complete data, the tests should be so conducted as to bring out quantitative values for these several properties. The temperature-rate of change of insulation resistance should be conducted in an enclosed atmosphere, as far as possible freed from moisture, heat being preferably applied by electrical means. The material having been previously thoroughly dried, will then show truer values for temperature changes.

The disruptive tests may be made by use of a step-up transformer or rotary transformer, and should be conducted under the above conditions with reference to dry atmosphere. Finally, tests made at any given temperature, but with variations in the percentage of moisture in the atmosphere, will show the influence of moisture on insulation and breakdown resistance. It is needless to add that such data would be of the greatest value in all classes of electrical construction, replacing mere guesswork by something approaching to certainty.

The insulation demanded by electrical conditions presents a most trying mechanical problem. Since all metals are conductors, insulation can only be effected by use of comparatively weak construction materials. Somewhere in the apparatus all the strain of its movable metallic members must be borne by a layer of comparatively weak material. For example, in the armatures of motors and dynamos, the strain of the torque on the conducting wires must be carried by the insulation. But examples are as numerous as the applications of electricity. In switches, the insulation between the blades and the handle is a source of weakness that as yet has not been satisfactorily overcome, and the difficulties of keeping large switches tight and firm are matters of common experience. The effects of constant pressure and high temperatures will inevitably loosen the best joints.

These mechanical difficulties also manifest themselves in an especially aggravating way in the overhead construction of trolley lines. Strain insulators, hangers, frogs and crossings, are far from being strong and reliable. If further argument be needed, let the reader attempt to design a section insulator or a crossing. But when to these mechanical difficulties are added the necessity for high insulation in all kinds of weather, with the assurance that all such devices will soon become coated with a layer of soot and dirt, the problem is so exacting that it cannot be successfully solved with the materials now obtainable. Here is certainly a wide field for development.

With the extension of electric traction to the operation of elevated and steam railroads have come new and exacting requirements for durable insulation under all conditions of weather. A most interesting chapter could be written on the problem of insulation for the third rail and feeders carried on the superstructure.

Though a great deal may be written on the subject of insulation, as much may be said on the care to be exercised in the application and use of insulation. In dissecting transformers, dynamos and motors, one can not but observe many evidences of careless work in construction. In many places the insulating covering of the wire is abraded, and poor winding often brings layers near each other with a dangerously high potential difference. Some extra strain thrown on such apparatus must sooner or later cause a burnout. In the shunt coils of a widely used make of arc lamp, the core being in circuit, a very thin insulation is used between the core and the winding. The self induction of these coils being very high, the strain of throwing the lamps on and off, and of static discharges during a thunderstorm, results in numerous cores being burned out.

But leaving the manufacture of apparatus, we find great carelessness in regard to saving the insulation from undue strain. Switches are opened on circuits carrying heavy currents with little thoughts of the consequences. In fact, the only consideration seems to be to make such a quick break as to avoid arcing. But what becomes of the energy which would otherwise start the arc? It spends itself throughout the system, with the result that sudden and severe strains are placed on the insulation of the active circuit. From this standpoint, circuit breakers and quick-break, or spring-impelled switches, only assist in aggravating this strain. The ideal condition would be to gradually reduce the current in a circuit to a small amount before it is opened.

Let us consider the conditions present in a loaded circuit. Each portion of the circuit has absorbed a certain amount of energy to establish about it an electromagnetic field, and when the circuit is a solenoid with an iron core, the energy stored in its magnetic field is considerable. Let the current be opened suddenly and the energy of its electromagnetic field is at once returned to the line, each portion of the circuit generates an electromotive force proportional to the strength of its field, and its time rate of change; or, to employ the familiar expression,

$$e = -\frac{dN}{dt}.$$

In sections where the flux is high, as in the armature, and the series and shunt coils of the field, it is readily seen that a high electromotive force of self induction results when the circuit is abruptly opened, and this electromotive force may be enormously higher than that to which such parts are subjected in normal operation, causing a proportionate strain on the insulation. It is noteworthy that such strains usually come on apparatus when it has become greatly heated from long running, and in consequence of the high temperature, the insulation is at its weakest. We also find the same chain of occurrences, though lessened in amount, when the main current is rapidly increased or diminshed by switching a feeder. Bad as these conditions are in constant current circuits, they are greatly emphasized in the case of alternating currents, by resonance and capacity effects.

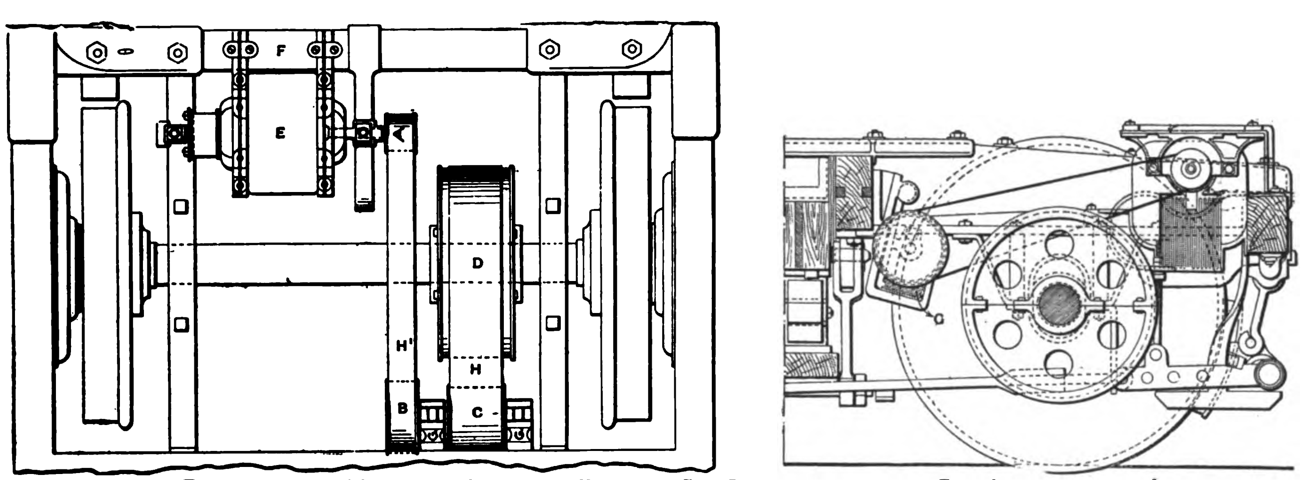
It seems that such conditions ought not to be so generally overlooked. Switches, and especially circuit breakers, should be provided with some device for more gradually opening or closing the circuit. Shunt windings of dynamos and motors might be protected by non-arcing discharge points, properly placed.

THE MOSKOWITZ ELECTRIC CAR LIGHTING SYSTEM.

DURING the past year experiments have been made on the cars of the Pennsylvania Railroad with a system of car lighting by means of storage batteries charged from a dynamo driven from the car axle. The system employed is that of Mr. Morris Moskowitz, of the National Electric Car Lighting Company, of New York, and the result of the trials has led to the equipment of a chair car on the Santa Fé Railroad, running between Chicago and Kansas City.

The system comprises a dynamo and its driving gear, a storage battery divided into two sets, a switchboard and a lamp circuit in the car. As will be seen in Fig. 1, the dynamo E is fastened to the rear of the car truck F, where it can be conveniently inspected. The transmission of power from the car axle to the dynamo is effected through a spring-cushioned counter shaft G, which is fastened to the truck bolster. On the car axle there is clamped a split wood pulley D. From this pulley the belt H drives the pulley C on the counter-shaft G. The other pulley B on the counter-shaft drives the belt H, which is directly connected with pulley A on the dynamo E. Both these belts are of double thickness. Another view of the spring-cushioned counter-shaft G is given in Fig. 2. The shaft is provided with a pair of helical springs in such a manner that the shaft and pulleys are able to give and take, and in this way cushion the vibrations of the car axle. The dynamo is entirely encased in a steel cylinder, which protects it from dust and water. The brushes are of carbon, and are so adjusted that they collect in both directions of the armature's rotation.

The dynamo is self-regulating under variable speeds. When the train has attained a speed of eight miles an hour the dynamo begins to generate its normal pressure of 45 volts. Should the train run at 60 miles an hour, the dynamo would be very little higher in electro-motive force, such is the regulation for a wide range of armature speed. This is accomplished by winding the fields differentially, so that an increased speed of the armature weakens the fields. In this manner the e. m. f. of the machine is maintained practically constant over a wide range of speeds of the car.



FIGS. 1 AND 2.—MOSKOWITZ SYSTEM OF ELECTRIC CAR LIGHTING FROM THE CAR AXLE.

The switchboard, which is generally placed in one of the closets of the car, has a number of ingenious features. As the system is entirely automatic, the controlling devices are all combined on the switchboard, Fig. 3. A is the main switch, which controls every circuit pertaining to the dynamo. If, for any reason, the dynamo is desired not to generate, all that is necessary to do is to open this switch. A 1 is the switch of the main light circuit. B is an ammeter showing the quantity of current generated at any time, and B 1 is a small resistance coil for the light circuit, which can be used if desired, but is not necessary. C is a special 12-point switch, which will be referred to later. E, F, G, H, and I are electro-magnetic devices, which control the dynamo and automatically change the polarity in accordance with the direction in which the train travels. Provision is also made for automatically opening and closing the main circuit between the dynamo and the storage battery, by taking advantage of the difference of pressure existing at times in either of them.

The 12-point switch C is used to control the whole system as follows: Two sets of storage batteries are used. One set is always connected to the dynamo-charging circuit, while the other is feeding the lamp circuit. When the battery on the lamp circuit is exhausted, the 12-point switch is turned, thereby switching the charged set on the lamp circuit and the exhausted set on the dynamo circuit to become charged again. It is impossible to change one and forget the other, as these operations all take place with one turn of the switch.

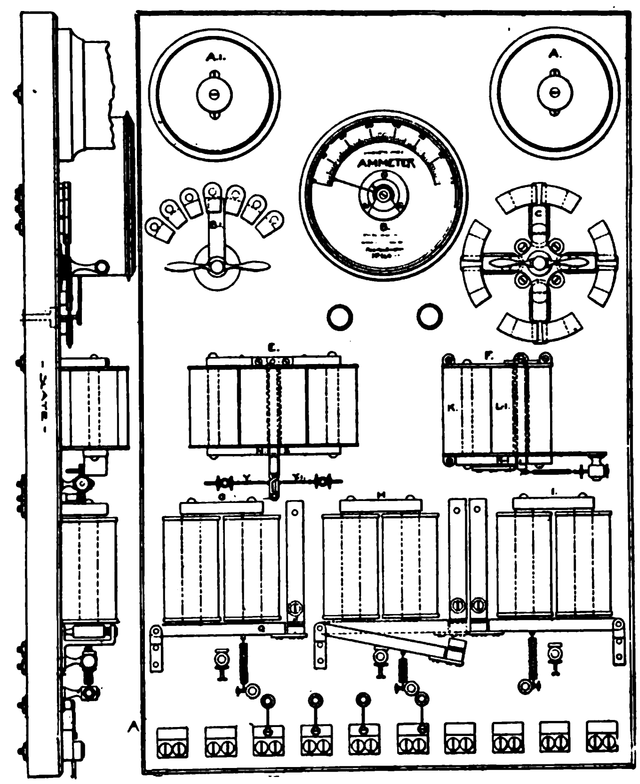


FIG. 3.—SWITCHBOARD, MOSKOWITZ CAR LIGHTING SYSTEM.

The storage batteries used in this system are made on a new design, by the company, for the sole purpose of electric train lighting. The standard equipment for a 60-foot passenger coach consists of 12 sixteen candle-power incandescent lamps in the car and one in each vestibule, making 14 lamps all told. We are indebted to the "Railroad Gazette" for the accompanying illustrations.

THE CANAL PROTECTIVE ASSOCIATION has sought to get State Attorney General Hancock to prevent alleged violations of the law in regard to the use of the towpath of the Erie Canal for Niagara power subway purposes. If the canal towpath exists for useful purposes it is hard to see what better use it could be put to than to furnish a way for the power wires.

LIGHTING A CATHEDRAL.

The introduction of a complete system of electric lighting into the Cathedral, East Logan Square, Philadelphia, was celebrated by a special public illumination and by a concert with a choir of sixty voices. The lighting effects obtained are admirable.

STATEN ISLAND ELECTRIC POWER COMPANY.

The Electric Power Company's property at St. George, S. I., has been resold by the referee. The purchaser was Paul D. Cravath in behalf of the Richmond Borough Electric Company, recently organized in the interests of Erastus Wiman. The business has accumulated under the receiver, Albert Boardman, nearly $80,000 in cash which, with the assets now realized on, will nearly liquidate the indebtedness of the company, and relieve Mr. Wiman of liability as endorser.

THE LIGHTING PLANT FOR YALE.

Inquiry fails to confirm the statement of the "Yale News" that the university authorities are planning an electric plant to supply all the university buildings. The matter has been examined and it has been found that the expense would probably be much higher than that of gas. The electric lights, however, have been placed in the new Phelps building, and their use may be somewhat extended. Under the present plan each student is responsible for the gas used in his room, and the statistics show that the cost is not excessive. On grounds of convenience many of the undergraduates favor the change.

LARGE ILLUMINATED SIGNS IN BOSTON.

The new Grand Theatre in Boston has gone in heavily for electrical signs. The Boston Edison Company has recently built and started for them, on the street mains, a big sign which goes right across the front of the theatre. It uses 625 lamps of 16 c. p. The upper line has the name of the house and the lower gives the prices of admission. The contract is that the sign shall be lit up three full hours every day. The theatre also has a sign built by the Edison Company a year or more ago, containing 300 lamps. It is placed diagonally across the corner sidewalk. Both these huge signs, taking nearly 1,000 lamps, are kept burning at once, and a great show is made, which attracts attention, excites comment in conversation and in the newspapers, and this pays the enterprising proprietor, W. Lothrop.

FLY WHEEL RUPTURE IN THE NO. 2. ROCHESTER, N. Y. STATION.

A defective fly wheel in the No. 2 plant of the Rochester (N. Y.) Gas and Electric Company burst a few days ago, breaking two steam pipe lines, endangering the lives of six men, and doing damage to the tune of $1,600. The engine room in which the accident occurred is 110 feet below the level of the street and 30 feet below the bed of the river. The wheel weighed twenty tons, with a 42-inch face, and a diameter of 18 feet. The accident happened about 2 a. m., throwing the city streets into darkness by the stoppage of a dozen generators. One of the engineers was badly scalded and burned. The exact cause of the trouble has not been determined.

MORRISTOWN, N. J., has taken up the subject of underground wires, with a subway commission, of which Mayor Quayle is a member. The citizens are also petitioning for the replacement of gas lights by electricity.

LITERATURE.

ELECTRIC WIRING SPECIFICATIONS FOR INCANDESCENT LIGHTING—By Geo. H. Kimber. New York, 1896, C. H. Irwin & Company; 59 pp.; 4½x6½. Flexible cover. Price, $1.25.

This little work is intended as an aid to architects and electrical engineers, and contractors in general, to guide them in the method of drawing specifications covering complete wiring installations. The author has very carefully sifted his material and introduced only the best and most up to date methods. As a matter of course we find here the general methods for direct and alternating two and three wire systems, as well as molding and conduit work of the various types now in general use. The author very properly added extracts from the Rules of the National Board of Fire Underwriters, which are always a handy thing to have about when drawing specifications. The little work ought to be of considerable assistance to all engaged in this class of work.

ROENTGEN RAYS.

ROENTGEN RAYS ACT STRONGLY ON THE TISSUES.

BY PROF. ELIHU THOMSON.

In some notes on Röntgen rays,[1] I have referred to an experiment made to determine the truth in regard to the effect which it had been claimed was produced locally upon the skin and tissues of those subjected for a prolonged period to the radiation from a Crookes tube. I noted the fact that after exposing the little finger of my left hand for half an hour close to the bulb, and about one and a quarter inches from the bombarded platinum, no decided effect followed until over a week; that the finger then reddened, became extremely sensitive, swollen, stiff, and to a certain extent painful. A slight blow or pressure would produce sharp burning pains.

I wish to add that at present, about seventeen days have elapsed since the exposure, and the finger is still quite sore, but showing signs of improvement. Two-thirds of the exposed portion is covered by a large blister which becomes larger each day. The pain and sensitiveness is less after the blistering takes place. The effect has not extended through the finger, but is confined to the back and sides, and is strictly limited to the exposed portion. Curiously, the skin over one of the joints of the adjoining finger, less exposed to the rays, became red and sore, but has become nearly normal without blistering, while a portion of the second finger on the side toward the source of radiation was reddened, but made only slightly sore and for but a short time only.

There is evidently a point beyond which exposure cannot go without causing serious trouble. It may also be that several shorter exposures would have an equal effect if made within a few days. The effect on my finger was made in a single exposure of half an hour at short distance, and by the law of inverse squares would be the same as from ten to twelve hours at six inches distance.

I do not think that the effect is electrostatic at all, as has been suggested, a view which I was at first inclined to favor, but the effect produced on the adjoining fingers which were further from the tube than the small finger and were electrostatically shielded by it, negatives the electrostatic theory. The evidence, so far as it goes, leads me to think that the effect is another indication of the chemical activity of Röntgen rays, of like character to the effect of the high pitch waves of light in causing sunburn, but penetrating more deeply into the tissues.

It remains to explain the long "period of incubation" which is peculiar, and is akin in effect to the well known period of incubation in various affections due to disease germs. Here might be the place to issue a caution to experimenters; it is: Do not expose more than a finger; be satisfied with the effect of, say, five hours' exposure at six inches distance, and do not prolong it to equal a longer time, or there may be cause for regret when too late. Personally, I have been quite more than satisfied with the results of my inquiry into the action of the rays on my own tissues.

FUNNY IDEAS ABOUT THE ROENTGEN RAYS.

Last week I was assisting at a large bazaar, says a correspondent of the London "Lancet," by holding a small Röntgen ray gallery, comprising a Crookes' tube, glowing, etc. As I in my temporary rôle of curator encountered many gems of exquisite unconscious humor, I venture to forward you a specimen or two as showing how a new-born scientific discovery is "understanded of the people." An elderly gentleman of prosperous appearance objected that the show was not "up to date," as he had "read somewhere in a newspaper that now you can see the liver palpitating and the heart circulating." Two elderly ladies entered the small room, and, solemnly seating themselves, requested me to close and fasten the door. Upon my complying, they said they wished "to see each other's bones," but I was "not to expose them below the waist-line," each wishing to view the apparatenly dismantled osseous structure of her friend first! A young and anxious mother asked me to see if her little boy had really swallowed a threepenny bit, as he was uncertain himself. She had read in the papers that a great doctor, Sir Something Blister (fact), in a speech in a large meeting in Liverpool a little while ago, said that a half-penny had been seen in a boy's "sarcophagus!" A young girl of the domestic servant class, taking advantage of her opportunity, as she thought, and my sex, asked me in confidence if I would "look through her young man unbeknown to him while he looked at the picture, to see if he was quite healthy in his internals."

[1] The Electrical Engineer, Nov. 18.

MECHANICAL.

ECONOMIZER TEST OF THE HOLYOKE, MASS., STREET RAILWAY POWER STATION.

BY SAMUEL M. GREEN.

I HAVE been interested in the paper by Mr. Richard McCulloch on "The Modern Power House," read before the American Street Railway Association, and in connection with it I have thought that the results of a recent test which I have made upon an economizer at the power house of the Holyoke Street Railway Company may be of some interest to your readers. The object of the test was to determine whether or not the economizer, under the conditions existing at this plant, could be considered a financial success.

The plant consists of three 200 h. p. Babcock & Wilcox boilers, each containing 2,059 square feet of heating surface, three 400 h. p. Greene tandem compound condensing engines 15-inch and 28-inch x 48-inches, three independent Deane vertical fly wheel air pumps and condensers, two Deane duplex boiler feed pumps, an induced mechanical draft apparatus consisting of two fans 96 inches in diameter, and two double vertical inclosed engines 6 inches x 5 inches, and a stack 72 inches in diameter and extending 46 feet above the grate level.

The feed water passes first through primary coil heaters, each containing 135 square feet of heating surface, through which the main engines exhaust to the condensers, then through a secondary coil heater containing 500 square feet of heating surface, and into which the condensing pumps, boiler feed pumps, and fan engines exhaust; then through a Greene economizer consisting of 288 tubes and containing 3,350 square feet of heating surface, and having a storage capacity of 2,000 gallons. With the present average output at the plant it is not necessary to use the fans as the stack gives sufficient draft, although its force is very small.

TEST OF HOLYOKE STREET RAILWAY POWER STATION, NOV. 11, 1896.

Average temperature of flue gas at boiler	387°
Average temperature of flue gas at stack	246.6°
Average temperature of feed water entering	44°
Average temperature of feed water in primary heater	101°
Average temperature of feed water in secondary heater	207°
Average temperature of flue gas in economizer	246.2°
Draft at boiler, inches of water	.08"
Draft at stack, inches of water	.10"
Coal consumed	10,100 lbs.
Combustible consumed	9,995 "
Ash	805 "
Water evaporated	99,197.5 lbs.
Water evaporated per pound of coal	9.82 "
Total watt hours	2,965,000
Average watts per hour	157,461.0
Average electric h. p. per hour	212.08
Duration of run	18 hrs. 50 min.

It will be seen by the results of the test given above that the water is being delivered to the economizer at an average temperature of 207 degrees F. With this temperature in the secondary feed water heater there was almost no escape of steam from the heater, showing that the heat in the exhaust from the air pumps and boiler feed pump was practically all being returned to the boiler. The results show that the economizer is certainly utilizing the heat in the waste gases to a very large extent, and that a saving of about 3½ per cent is being effected. This saving upon the amount of coal at present consumed amounts to about $210 per year, or about 6 per cent. upon the capital invested in the economizer. If, however, the plant were running at twice its present output, the return upon the invested capital would be 12 per cent. at least, and it would probably be even larger, as the gases from the boilers would be hotter, and the resulting temperature of the feed water somewhat higher. The load at this plant is exceedingly variable, one engine carrying it during most of the run, but at certain times during the day two have to be used. This necessitates keeping one fire banked ready for use at a moment's notice. With this considered, I think the showing very creditable.

The feed water was measured by a Worthington meter which had recently been calibrated.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—VIII.

BY LIEUT. B. A. FISKE, U. S. N.

THE service trials held with instruments in the U. S. flagship San Francisco for one year and subsequently in the U. S. S. Cincinnati for four months were satisfactory; and the system is now installed on a comprehensive scale in the battleships Maine, Texas, Indiana, Massachusetts and Oregon, and is about to be installed in the armored cruiser Brooklyn and the battleship Iowa.

Resistance of each galvanometer, 60 ohms.

Weight of each galvanometer, 22 lbs.

Diameter of each galvanometer, 10 inches.

Resistance of each transmitter box about 3.7 ohms, the wire being 22 gauge.

Resistance of each receiving box about 17 ohms, the wire being 26 gauge.

Sticking of the Galvanometer Needles.—This is not likely where instruments are run from a dynamo current, because the fact that a dynamo current is not uniform, but pulsating, gives the needles a minute vibration, which shakes them on the pivots and antagonizes any tendency to settling at one position.

In case a galvanometer does stick, however, the sticking will be due probably to one of two causes; first, the needle may stick on its pivot; second, there may be a little dirt, specially iron filings, attracted by the magnet, between the moving bobbin and the poles of the magnet between which it moves. Either one of these contingencies is improbable, if the instruments have been carefully tested after installation and then closed tight. But in case the needle does stick, the second trouble is the more probable one. The best way to hunt for it is to take off the cover of the instrument and hold an incandescent light so as to illuminate the interior, assisting the illumination by placing a sheet of white paper behind the moving coil. Any dirt can then be seen, and can be removed by a fine magnetized steel wire used as a probe. In case this annular space is clear, the difficulty will probably be in the pivot, and caused by the loosening of the little screws which adjust the pressure between the conical ends of the steel pivot and the agate bearings in which it rests at each end. The steel pivot ought to rest loosely, that is, not tightly, between its agate bearings, and the correct adjustment is made in manufacture and the adjusting screws are supposed to be set up tight, so as to prevent disadjustment. But in case the adjusting screws become loose, they must be reset. The only way is to tighten and loosen, carefully and by slow steps, until an adjustment is secured, such that the needle does not stick in any position.

Notes.—In the actual installation of the helm indicator and steering telegraph, each galvanometer of the helm indicator circuit is placed close to a galvanometer of the steering telegraph circuit; and both galvanometers are lighted from the electric light circuit and from the same rheostat, though in cases where the use of rheostats is inconvenient, small lamps using the full voltage of the light mains may be employed. In the case of the transmitter galvanometers of the steering telegraph and the receiving galvanometer of the helm indicator circuit, which are placed near them, the connections for their lights may be taken from the same rheostat as is used for the transmitters themselves, as shown in Figs. 7 and 8, the lights being connected to the binding posts, bc and cd, respectively.

The same arrangement may be used for connecting the range indicators to the electric light mains of the ship, and for lighting them.

Regarding the external resistances for the helm indicator and engine telegraph circuits, which are preferably placed in series with the circuits, as shown in Figs. 1, 10 and 11, it is sometimes better to use two equal resistances instead of one for each circuit, one resistance being connected to the positive light main, and the other to the negative. The reason is that in many ships, the light mains are connected together through two lamps which are in series with each other, and the wire joining the two lamps is connected to ground, the arrangement forming a "ground detector" The two mains become thus forty volts above and forty volts below "ground," respectively (supposing the total voltage to be eighty) If, therefore, two equal rheostats are employed, the helm indicator and engine telegraph circuits themselves will never be more than about two volts from "ground," so that the chance of a "ground" in either circuit is extremely small. For the same reason it is better, in the case of the steering telegraph circuits, to connect the transmitters to binding posts h f. Figs. 7 and 8, which are about midway between the two ends of the rheostats and at nearly zero potential or "ground."

All of the ship telegraphs and their lamps can be run, if desired, direct from the electric light mains of the ship without the introduction of any external resistance in their circuits, as it would be merely necessary to design them for the full voltage of the ship. But in view of the difficult conditions of ship life, especially in avoiding leaks and "grounds," it is thought that the low voltage system is the safest. The galvanometers may be made of convenient sizes for special installations.

If the radius of the wire of the transmitter of the helm indicator circuit is as great as 22 inches, the length of wire swept over by the traveling contact is sufficient to give the requisite deflection of the galvanometers, without using too great a current in the transmitter wire or too weak a spring in the galvanometers. It is safer, therefore, where the necessary space can be obtained, to use a radius not less than 22 inches.

THE LIGHTING OF THE TONAWANDA FURNACE BY PRESIDENT-ELECT McKINLEY.

THE promised revival of business and returning prosperity predicted upon the triumph of sound money in the late election, has not been long in manifesting itself. Indeed, the day after election the wheels had begun to turn in establishments which had stood idle for months, and with them thousands of hands resumed their wonted and longed-for activity.

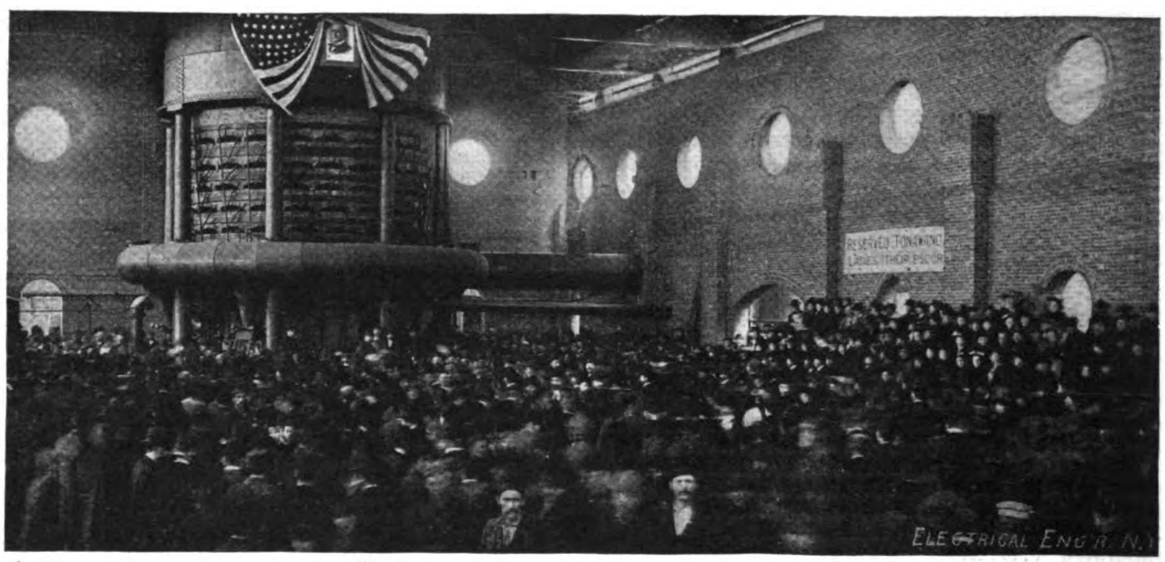
Among the establishments which had thus awaited the signal of advance was the Tonawanda Iron and Steel Company, of North Tonawanda, N. Y., whose new furnace, built at a cost of $250,000, had never been blown in, though completed several months ago. The result of the election, however, led to the determination to put the furnace in blast at once, and to emphasize the inauguration of the new era of prosperity, Maj. McKinley was asked to start the fires by electricity from his home in Canton, O.

To carry out this, the following simple means were adopted: There are seven tuyere openings about the hearth of the blast furnace, through which air is blown, and in lighting the furnace it is necessary to have it evenly lighted all around. Wires were strung around the bosh of the furnace, with an incandescent lamp opposite each one of these tuyere or blast openings. The upper part of the glass bulb of each lamp had been cut off, leaving a little cup around the socket, which was filled with gunpowder that piled up around the filament, so that when the current heated the filament the powder ignited; this, in turn, lighted cotton waste saturated with kerosene that was suspended over the bulb; the waste led into the interior of the furnace where about ten cords of wood and probably 1,000 tons of coke had been placed.

The Western Union Telegraph Company very generously gave the use of the wire free of cost from Maj. McKinley's home, at Canton, to the furnace itself. A dynamo was in operation at the furnace, so that when Mr. McKinley, at 3:30 p. m., November 5, touched the key at Canton, it completed a circuit between the dynamo and the wires around the furnace, which lighted the furnace in the manner above outlined.

This is the first time a furnace has ever been lighted in this manner, and some of the visiting iron manufacturers predicted a failure, but in every detail it was a complete success. The furnace was fired at every opening, connections were immediately made with the blowing engine, air was turned on and the owners state that the furnace started in better shape than they have ever seen a furnace start before. Since then it has been doing excellent work. The first cast was foundry iron, which is something unusual, as the first cast of a new furnace is expected to be poor.

The ceremony was witnessed by over 5,000 persons, and our engraving gives a view of the furnace as the crowd was beginning to gather. We are indebted to Mr. W. A. Rogers, president of the Tonawanda Iron and Steel Company, for the above details of this interesting event and for the photograph reproduced in the accompanying illustration.



FURNACE AT NORTH TONAWANDA, N. Y., LIGHTED BY PRESIDENT-ELECT MCKINLEY FROM CANTON, OHIO.

EXPERIMENTS WITH INCANDESCENT STREET LIGHTING IN DENVER, COLO.

DENVER is one of the cities that has had experience with street lighting by means of incandescent lamps, and we are indebted to Mr. John H. Poole, general manager of the Denver Consolidated Electric Company, for a statement of some of the results. He says: "We put in originally what is known as the Edison municipal system for street lighting. We installed in this city about 1,200 of these lights. Soon after this installation a demand for the replacement of these lights by arc lights in the business section was begun, and a gradual displacement of the entire system followed. This was all in deference to the public demand for arc lights which seemed to give much better satisfaction. Unquestionably they furnish a great deal more light for the same amount of money. The direct loss to this company was in the neighborhood of $100,000. This was due in part to the continual changes and re-arrangements of lines necessitated, and to the ultimate loss of all the machinery, wire, posts and fixtures. We put in originally also a number of towers, which were subsequently removed, in accordance with the popular demand, involving a still further absolute loss to the company. We now have arc lights suspended from the intersection of streets, and they seem to give general satisfaction to our citizens. All the changes above referred to were made in compliance with the public wish, and not in accordance with our own, as we were not only put to the complete loss of the old system, but the expense of installing a new one. We say, therefore, without hesitation, that the preference of the people in Denver is decidedly for arc lights." This will be interesting data for St. Louis, where it is now proposed to substitute incandescents for arcs on the streets.

PERFORMANCE OF THE THOMSON WATTMETER.

Our readers will recall recent correspondence carried on in our columns between Mr. Milne and Mr. C. D. Haskins regarding the merit of the Thomson recording wattmeter. We learn that within the past month a series of important tests have been made to determine the accuracy of the meter in question under certain conditions. The tests were carried out to verify sundry criticisms to the effect that on rapidly fluctuating loads the meter was derelict in its accuracy, especial reference being had to elevator work.

The object of the tests was the determination of the mean error under maximum conditions of fluctuation and the result was gratifying from the standpoint of the meter. It was found that the maximum of error, introduced by this character of load—that is, under the worst possible or maximum condition of fluctuation, did not exceed sixth-tenths of 1 per cent., a percentage materially reduced under conditions less than the maximum.

NEWCASTLE, England, is to have an electrical and engineering exposition next year in commemoration of the Queen's long reign, surpassing in length that of any other English sovereign. It will be international in character.

THE JACQUES CARBON GENERATOR.

MUCH has been written of late about the invention recently patented by Dr. Jacques, of Boston, by which it becomes possible to obtain electricity directly from coal; and while Dr. Jacques has been widely complimented on his discovery and the highest scientific authorities who have examined it have been enthusiastic in their praise, there has been, as might naturally be expected in an invention of this importance, some unfavorable criticism based upon alleged misconception as to what the invention is and a lack of published data as to its capabilities.

In a letter published in The Electrical Engineer, of July 22, 1896, Mr. C. J. Reed said that it seemed to him evident that the electrical energy derived from the Jacques cell or generator, instead of being evolved directly from the carbon, was produced by a thermo-electric junction. In the "Journal of the Franklin Institute" for July, there appeared a paper communicated by Mr. Reed to the Institute, concerning a method of his own for deriving current from coal, though indirectly, and this is reported in the same journal to have been followed by certain experiments with "an extemporized Jacques cell," by which he sought to show that the consumption of carbon, or even its presence, was not at all essential to the operation of the cell.

These assertions of Mr. Reed, and the accounts of the experiments referred to, have been very widely copied and commented upon. Further criticisms have been made by various writers, that such reports of the efficiency of the Jacques process as have been published are based upon the amount of carbon consumed within the pots, and no data is given as to the amount of coal consumed upon the grate or the power necessary to run the air pump—factors which evidently might greatly modify the commercial efficiency of the apparatus when put into use.

Up to the present time no authoritative reply to these various criticisms has appeared. But in the Christmas "Harper's Magazine" we find a most interesting article by Dr. Jacques, in which the whole story of the invention is told; and these various criticisms, although not especially mentioned, seem to be effectually answered, as the following extracts show:

"That the electric current was due to the chemical combination of the oxygent of the air with the coke (carbon) there could be no doubt. Quantitative tests showed that oxygen was taken from the air; that the carbon was consumed; that carbonic acid was formed. Moreover, the electromotive force obtained agreed almost exactly with that which is theoretically obtainable from the combination of oxygen with carbon to form carbonic acid (1.04 volts). That the phenomenon was not due to thermo-electric action was proved by the fact that when the whole apparatus was so inclosed that all parts were kept of uniform temperature the maximum electromotive force and current were obtained. Again, later experiments with far larger apparatus have not only confirmed these results, but have shown that under proper conditions the electrical energy obtainable from one of these generators is substantially equal to the potential energy of the weight of carbon consumed within the pot."

The remaining criticisms would seem to be abundantly answered and the commercial aspect of the invention shown by the following extract: "As compared with modern steam engines, only relatively small carbon electric generators have as yet been built; and it should be remembered that with this generator, as with the steam engine, increased size means increased efficiency per pound of coal, particularly in the coal consumed on the grate. Following, however, are some results of a test (made by experts not connected with the development of the invention) upon a small and comparatively crude 2 horse-power carbon electric generator that has been in occasional use for some six months:

Average electrical horse-power developed	2.16	h. p.
Average electrical horse-power used by air pump....	0.11	"
Average net electrical horse-power developed.......	2.05	"
Carbon consumed in pots per electrical h. p. hour....	0.223	lb.
Coal consumed on grate per electrical h. p. hour......	0.336	"
Total fuel consumed per electrical h. p. hour....	0.559	"
Electricity obtained from 1 lb. of coal (of which 0.4 lb. was consumed in the pots and 0.6 lb. was burned on the grate)......	1,339	watt hours

or 32 per cent. of that theoretically obtainable.

"Thus the efficiency of this particular generator was twelve times greater than that of the average electric light and power plant in use in this country, and forty times greater than plants of corresponding size.

"There are, however, many details still to be worked out, and many improvements yet to be made, before the carbon electric generator can be put into general commercial use on a scale comparable with that of modern steam engines."

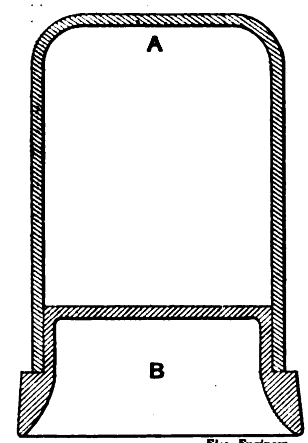
We need scarcely say that the figures given by Dr. Jacques will be welcomed by many who have heretofore looked askance at the Jacques generator for want of data regarding its performance. Even though the generator consumes 50 per cent. more coal on the grate than was absorbed in the purely electrical work, the results are, nevertheless, gratifying and may well encourage Dr. Jacques in pushing still further toward perfection. The "electricity direct from coal" problem is the most important one on the tapis at the present time and we are reliably informed that a scientific syndicate, if we may so term it, is at work at it in the the United States.

WEATHER-PROOF APPARATUS.

BY CHARLES WIRT.

BEING of the opinion that much has yet to be learned regarding the best methods of weather proofing apparatus intended to be exposed out-doors, the writer wishes to describe a somewhat peculiar performance of the weather proof casing of a lightning arrester. The accompanying cut shows the casing in section. The cover A being a bell shaped, solid drawn brass shell, fitted over the base plate B, which was turned to give a good, easy fit. The cover being in one piece and seamless, it was considered that with a rather long and well-fitted joint, this case would be above suspicion as to weather proof character. After extended experience, however, a few cases were found where water had undeniably found its way into the interior. That this had occurred, was at first hard to believe, but like the case of the man who "could not be put in jail," and was already locked up, the water was there, in very small quantity, but not to be disputed.

After some speculation, a reasonable solution was suggested,



SUPPOSED WEATHERPROOF COVER.

which is, no doubt, a correct one. The joint, although closed and mechanically good, was, of course, not air-tight, and the temperature variations occurring from day to day, and from hour to hour, would, of course, expand and contract the contained air, causing a slight, but appreciable, transfer of air from inside to outside with a rise of temperature, or from outside to inside with a falling temperature. In case of a shower, a film of water would cover the lip of the casing where it meets the shoulder of the base plate. This would form a complete water seal, and on contraction of the air inside, as would be most likely to occur from the fall of temperature usually accompanying such a shower, this film of water would be drawn into the interior. With a badly made joint, or one having somewhat irregular contact between the parts, this trouble could not occur, as a water seal cannot be made to fill more than a very small space.

In this connection a mistaken idea, and a very common one, regarding protection against weather and damp, might be alluded to. This is the idea: That damp can be excluded from the interior of a box or case by any kind of seal, which is not absolutely air-tight. An incandescent lamp might be considered as a good example of an air-tight receptacle. It is evident on reflection that variations in pressure continually occurring in the atmosphere will cause air to enter and leave any closed space, unless such space is sealed in such a way as to resist the pressure changes. Consequently the interior of such receptacles not hermetically sealed will represent the average humidity of the external atmosphere, the interior changes in humidity being less rapid and less extreme than the changes in the surrounding air.

THE

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CONTENTS.

COMPRESSED AIR.—A CRUCIAL TEST.

FOR some time past the engineering world has been put on the qui vive by the advocates of compressed air, who have with assiduity sought to prove that this agent is more economical as a power-transmitting medium than is electricity, not only for the operation of stationary motors of all kinds, but for railway cars as well. We have no fault to find with the honest convictions of any one, but unfortunately for our compressed air friends, the works of daily practice are the best evidence that it is a delusion which has taken hold of them. By this we do not mean to imply that there are no uses for compressed air; quite the contrary. We believe and are convinced that for many purposes, too numerous to mention here, compressed air, as such, but not as a substitute for electricity, has a wide field open to it. Nor are we unmindful of the fact that under certain conditions compressed air may have collateral advantages which may in certain cases involving ventilation and fresh air supply make it preferable to electricity.

The limits of successful compressed air transmission as compared with electric transmission have been the subject of numerous essays from the highest authorities in engineering, and the question is now to be found discussed in all text books on the subject, so that it is not necessary for us to go into detail. But an actual example is worth a volume of theorizing, and we are fortunate in being able to present in this issue an authentic account of a comparative test between the two forces under discussion. This test, carried out by Mr. Lewis Searing, a well-known Western mechanical engineer, showed that the total efficiency of a compressed air mine pumping plant was only 9 per cent.; that is, it took 312 horse-power at the steam cylinders of the compressors to do the work equivalent to 28 horse-power as measured by the amount of water pumped against a given pressure. The electric plant installed accomplished similar work at an efficiency of 44 per cent., notwithstanding the fact that both the dynamo and motor were underloaded.

So far as the efficiency of the compressed air plant is concerned, we must confess that we are not surprised at the result, when one considers the length of transmission. What with the loss in compression, leaks at joints and loss of pressure due to friction in the pipes, together with the low efficiency of the compressed air pumps, the wonder is that the showing was as good as it turned out to be. It may be objected that it is hardly fair to single out an exceptional case like this and hold it up as a basis for the general condemnation of an entire system. Such is not our intent. What we desire to emphasize, however, is our belief that few compressed air plants can to-day stand a rigorous comparative test with electricity without showing such a decided difference in favor of the latter that further operation by air would be considered disadvantageous.

The tests of Mr. Searing also throw some light on what may be expected from compressed air as a motive power for street cars. True the conditions are not absolutely identical, but the only essential difference is the absence in the case of street cars of the connecting pipe between the compressor and the air motor on the car. We leave it to our readers to make their own conjectures as to the allowance to be made for this difference and to calculate how much would have to be added to the 9 per cent. efficiency of the pumping plant to compensate for the removal of the connecting pipe.

NIAGARA POWER IN BUFFALO.

SOME weeks ago we illustrated and described all the features of the pole line and circuits for the Niagara transmission to Buffalo, and we are now able to give, again for the first time, the full details of the apparatus used at both ends of the line, for stepping up the current and then for stepping it down and changing it to direct. All these details will be found full of interest, especially in view of the fact that on

Wednesday last the current was actually thrown into the street railway service and used for operating the cars.

We shall soon be able to see how the new power in Buffalo is able to compete with the old sources of supply in coal and natural gas. If the figures given in Buffalo be correct, steam power there to-day, with coal at $2 per ton, is costing on lots of 50 horse-power, ten hours daily, about $55 a year per horse-power. Against this may be put the charge to the Buffalo Street Railway of $40 per year, per horse-power, 24 hours daily, for the first 1,000 horse-power and $36 per horse-power for that subsequently taken. Even putting the steam power on the larger basis, there would seem to be no comparison, and to small power users the saving would appear to be as large as it is to concerns taking the Niagara power in big blocks. The working out of these conditions will be of great interest. To-day Niagara Falls has become part of the resources of Buffalo, and nothing can stand between that city and its great future.

It will not be forgotten that the 35-mile San Joaquin-Fresno plant is in operation. Moreover, as we go to press, a terse communication reaches us from Mr. T. A. W. Shock, general superintendent of the Sacramento Electric, Gas and Railway Company, reminding us that he has been transmitting power 22½ miles, from Folsom, for a year and a half, for light and power, and for operating 22 miles of street railway. "Not a night goes by but that our load runs from 1,800 to 2,000 horse-power, so that the transmission of 1,000 horse-power a distance of 22 miles is not an experiment but an assured fact." The honors, therefore, still seem to rest with Mr. Shock, whose results are full of encouragement to his Eastern rivals in this power transmission.

STANDARD REQUIREMENTS FOR INCANDESCENT LAMPS.

THERE is perhaps no more vexatious question which the central station manager has to deal with than the procuring of proper incandescent lamps for his circuits. When he purchases a dynamo or a motor or a transformer, a test extending over an hour or two enables him to determine whether the manufacturer has lived up to his guarantees, but in the case of the incandescent lamp nothing short of the actual running of the lamp for the larger part of its life can indicate its true worth. How to remedy this evil must no doubt be a subject of frequent cogitation with large consumers of incandescent lamps. Other questions, relating to this subject, such as the standardizing of the bases, are beginning to receive proper attention, but the most vital of all, it seems to us, namely, the formulation of a standard of life and efficiency, has still to receive its due recognition. But while Americans are still haggling over lamp bases, our German cousins have gone at the more vital question above referred to and some time ago the Verband Deutscher Electrotechniker appointed a commission to investigate the subject and submit a set of standard rules and regulations for the guidance of all interested in the handling of lamps, whether as consumers or manufacturers. This commission, on which both makers and users were represented, has drawn up its report which will be submitted at the next annual meeting of the Verband, and as it touches a question which must sooner or later come up actively in the United States it may be well to point out in brief the salient points of the proposed standard requirements. The latter, among other things, permit of a variation of 2 per cent. in the voltage marking of lamps ordered, the lamps to be tested at the voltage marked on them. A variation of 6 per cent., either way, in candle power or energy consumed, is allowed; but if more than one-fourth of the lamps tested exceed these limits, the whole lot may be rejected.

The standard of life of the lamp is taken to be the number of hours at the end of which the lamp has lost 20 per cent. of the candle power marked on it when running at its normal potential. Other clauses of the regulations refer to the submission of disputes to third parties, the court of last resort being the Physikalische Reichsanstalt in Berlin. No claims can be made after 30 days and then only, when 2 per cent. of the lamps remain untouched and available for test. The minimum number of lamps in any event must be 20.

We note also that the commission recommends the adoption of the Edison lamp base for general introduction, a step which will probably not be without due influence on the action of the committee of the National Electric Light Association now engaged in investigating this particular question. It is a pity, indeed, that the American Committee's work should be so limited. Not that the lamp base matter is of small importance, but the whole question of the incandescent lamp as regards the relations between manufacturer and user is still in such a chaotic state that it is high time order were brought out of it. Now that both sides have got together on the lamp base, would it not be just as well for them to extend their labors and settle once for all a matter of paramount importance to the whole industry? We would suggest that President Nichols, of the National Electric Light Association, could in no better way insure the permanent fame of his tenure of office so auspiciously begun, than by bringing about so desirable a result.

SOCIETY AND CLUB NOTES.

MR. JOSEPH SACHS ON HORSELESS CARRIAGES.

A very interesting and instructive lecture on the subject of "Horseless Carriages" was delivered before the New York Electrical Society on Nov. 19 by Mr. Joseph Sachs, who also repeated the lecture in a more popular form before the Henry Society on Nov. 20. The lecturer traced first the history of the subject, dwelling upon the growing importance of transportation, and then showed how, within the past year or two, experiments of the earlier inventors had now crystallized into definite types. He divided horseless carriages into three main classes—steam, gas and electric—and then suggested that these also had their subdivisions according to the service required. It was pointed out that the question of motive power was but one among many, the others dealing with the design of the body, steering, gearing, controlling apparatus, attendance, cost of operation, facility of renewing supplies, speed, grade climbing ability, weight, comfort, safety, etc. All these considerations were rapidly touched on in the review of the various types of carriages, a large number of which were illustrated in perspective and by diagram. Mr. Sachs had on exhibition, to illustrate his remarks on the electric carriage, two of the small Riker motors that have been so successfully employed in this class of work. Mr. Sachs said that in every respect the electric carriage of to-day was at once ideal and practical—as a carriage—but he thought much improvement was still desirable and possible as to the batteries or source of current.

LETTERS TO THE EDITOR.

A PROPHECY AS TO THE BERLINER SUIT.

The lucubrations of some of your contemporaries who have law departments as sideshows have always been entertaining to the "profesh." They all shoot wide of the mark in the Berliner business, or rather, they shoot very large charges of very small missiles, and as a consequence bring down nothing.

I venture to say that the Berliner patent suit now before the Supreme Court will be disposed of on these legal propositions only and the suit dismissed.

No granting power, kingly or otherwise, is given to canceling grants made with due deliberation and in due form, especially where that grant has the sanction of a statute, excepting upon one or two grounds, to wit: First, That the grant was obtained by fraud or misrepresentation of the grantee. Second, That the grant was made in ignorance of the equitable rights of others upon whom the grant is found to work a gross hardship or injury and that no legal machinery exists to cure the mistake.

The court will not find for the government on either of these propositions, and as to the other points, that there was no invention or that the application hung a long time in the Patent Office, or that the Commissioner was mistaken in his judgment upon the subject of the introduction of new matter into the application by amendment and otherwise, it will hold that the statutes provide for an inquiry, (when an inquiry is admissible), in a different kind of suit. B. S.

New York City, Nov. 19, 1896.

Power Transmission.

INAUGURATION OF THE NIAGARA-BUFFALO POWER TRANSMISSION.

BY ORRIN E. DUNLAP.

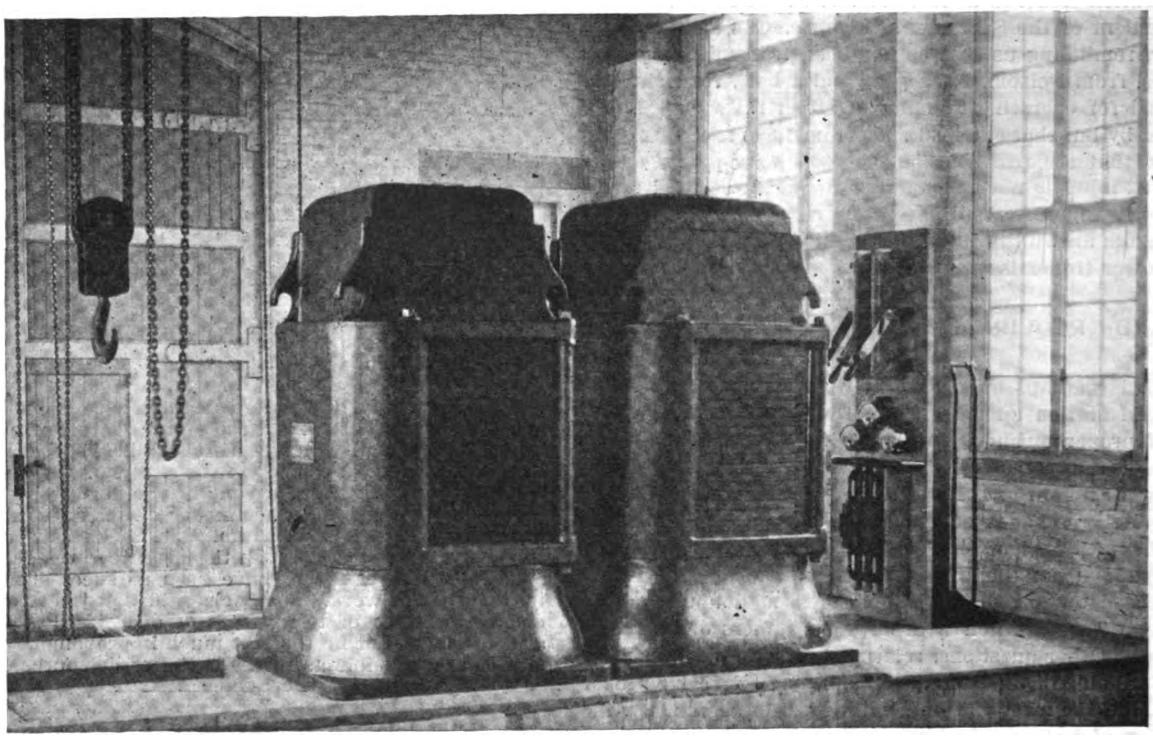
THE greatest event in the history of the power development at Niagara Falls occurred at 12:01 o'clock on the morn- of Monday, November 16, when Mr. William B. Rankine, secretary of the Niagara Falls Power Company, threw the switch that sent a portion of the power from one of the huge generators into the transformer house, adjoining the power station, where it was passed through transformers and transmitted to Buffalo.

A few minutes before midnight Secretary Rankine, William A. Brackenridge, M. Am. Soc. C. E., chief engineer of the Cataract Construction Company, and Paul M. Lincoln, electrical superintendent of the Niagara Falls Power Company, mounted the switchboard platform, and at one minute after midnight Mr. Rankine threw feeder switch No. 4 releasing the power into the transformer house, where Mr. J. R. Edmonds, the Niagara Falls representative of the General Electric Company, was on duty. He closed the high tension switches and connected the transformers to the line. The low tension switch was thrown and the current passed into the transformers and out over the line to Buffalo. Everything was found to be in perfect working order. At the Buffalo end of the line, in the Buffalo Street Railway Company's plant, were gathered Mr. W. L. R. Emmet and Thomas H. Fearey, of the General Electric Company; George Urban, Jr., president of the Cataract Power and Conduit Company; Edgar B. Jewett, mayor of Buffalo; H. H. Littell, general manager of the Buffalo Street Railway Company, C. R. Huntley and other men prominent in the affairs of that city.

The Niagara Falls Power Company's contract with the Buffalo Street Railway Company calls for the delivery of 1,000 horse-power at $36 per horse-power per annum. This power will be taken from the bus-bars into which the big generators feed in the power house.

In connection with this installation it may be stated that the General Electric Company entered into three separate contracts, and therefore three separate companies are interested in the apparatus installed. The first contract was made with the Cataract Construction Company. This was for three air blast transformers, blower motor, switchboards, etc. Each of these transformers is of 1,250 horse-power capacity, and any two of them can be used to transform 2,500 horse-power delivered to them in two-phase currents at 2,200 volts to three-phase currents at either 11,000 or 22,000 volts. In these transformers the coil connections are so arranged that the change in the voltage from 11,000 to 22,000 can be easily effected. Both the primary and secondary connections of the transformers lead to a switchboard. The low tension board is fitted with switches and fuses, while the high tension board is fitted with switches, fuses and current indicators.

Under their contract with the Cataract Construction Company the General Electric Company have installed the transformers with all cables, connections, etc., from the generators in the power house to the transmission line. Lightning arresters have been placed in a small building on the south side of the transformer house at the point where the cables leave the building. The third transformer furnished under this contract is held in reserve. The design adopted for the Niagara installation is such that it can be extended until the full capacity of the transformer house is reached. The transformers are each 7 feet 10 inches high, and measure 5 feet 4 inches by 4 feet 8 inches at the base. Each weighs about 25,000 pounds.



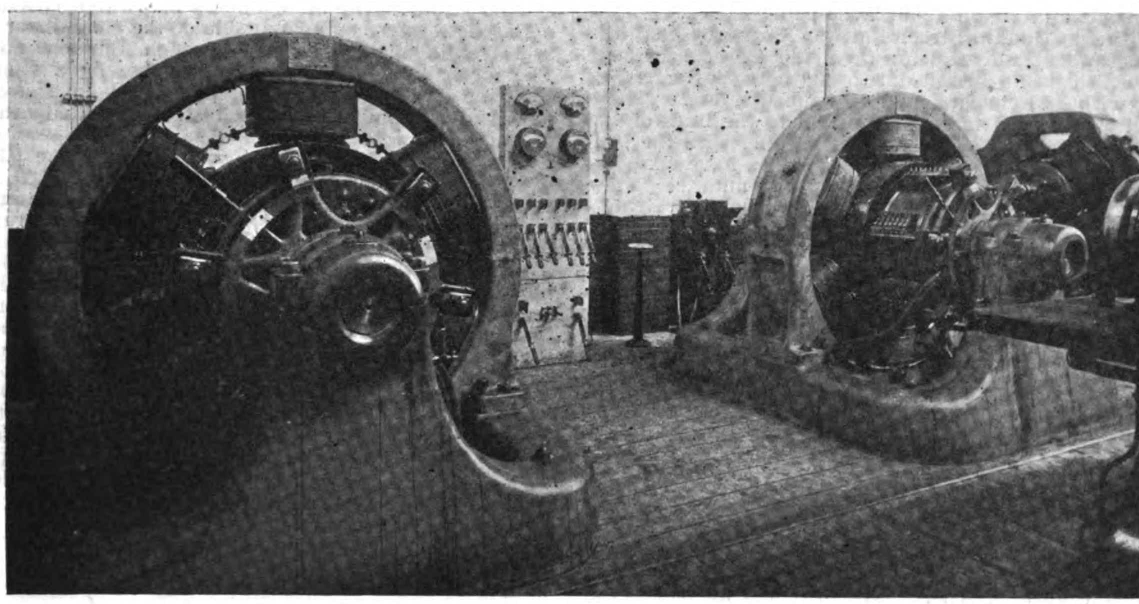
General Electric Step-Up Static Transformers in Niagara Power House.

The two transformers now in place stand at the eastern end of the transformer room and are supported on an iron framework, their bases being 8 feet below the floor of the transformer house. The space below them is practically an air-tight enclosure through which all connections to the transformers are made. In the pit below the transformers there is ample room for walking about, all conductors and connections being supported on large porcelain insulators and iron brackets. The connections to the transformers are made so that they can be detached without much trouble, and at any time when it is found advisable to substitute the extra transformer for one of those now in service, these connections will be opened and the transformers changed with the aid of a crane.

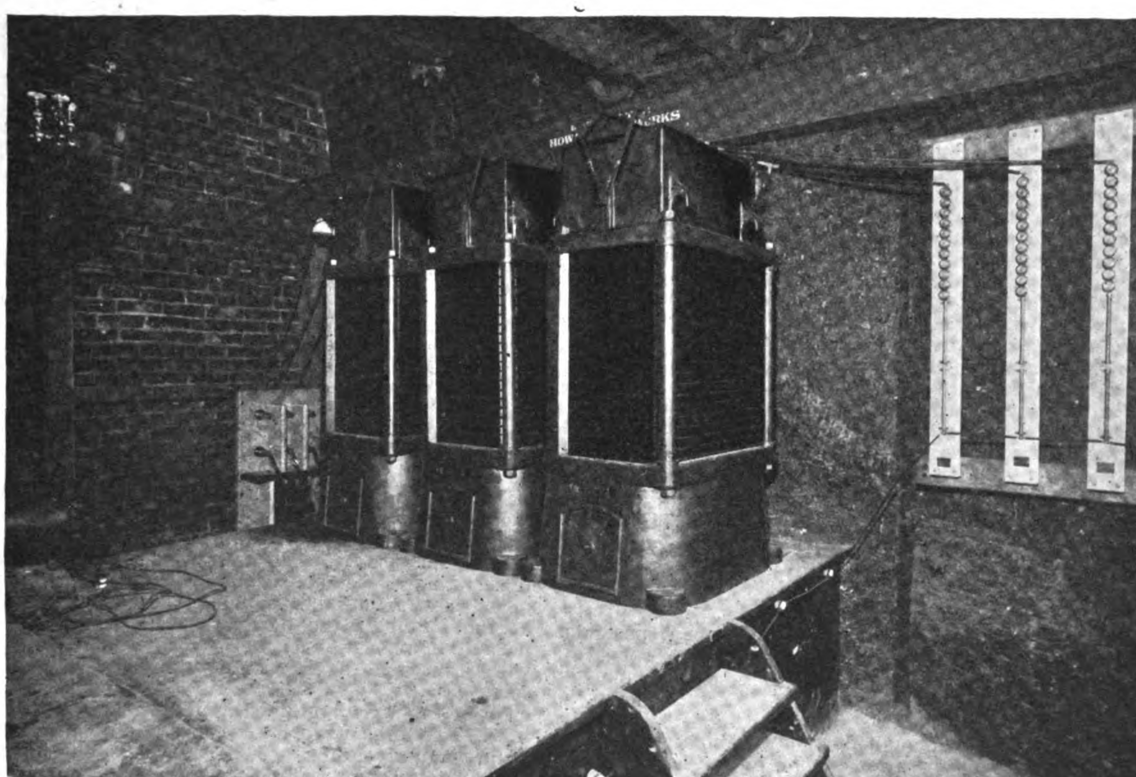
In the southeast corner of the transformer room stands a large centrifugal blower which is driven by a 5 horse-power electric motor, which stands close beside it. This blower delivers air to the enclosure below the transformers, from which point the air passes upward through spaces provided between the coils, and also by a separate space, provided between the laminations of the iron. The amount of air delivered in each of these places is controllable by valves, so that the tem-

perature can be suitably adjusted with the minimum load on the blower motor. The arrangement of coils in these transformers is such that very strong insulation will have to be punctured before connection can be made between the different coils, or between the coils and the iron. At the same time the air spaces are so placed that the air is brought intimately in contact with each coil and gives an excellent cooling effect. This method of cooling makes necessary the occupation of a good deal of space in insulation and air, which has a tendency to increase the size of each transformer. Still, it is very apparent that it has the very great advantage of making the transformer clean and accessible, and much more convenient to handle than a transformer cooled by other methods.

The second contract the General Electric Company entered into in connection with the Niagara-Buffalo transmission was with the Cataract Power and Conduit Company, of Buffalo. This company was incorporated July 17, 1896, with George Urban, Jr., as president, and they will be the distributing agents of Niagara power in the city of Buffalo. Among others interested in this last named company are William B. Rankine, D. Ogden Mills, John Jacob Astor, Edward D. Adams, Francis Lynde Stetson, E. A. Wickes and Daniel O'Day. Their contract with the General Electric Co. called for four 265 k. w., or 360 horse-power transformers to be used in reducing the current from the line to a voltage suitable for connection to 500-volt rotary converters. These transformers are installed in a special building connected with the Buffalo Street Railway Company's power house. Their general construction and the



THE GENERAL ELECTRIC ROTARY CONVERTERS IN POWER HOUSE OF BUFFALO STREET RAILWAY CO.



INTERIOR OF STEP-DOWN TRANSFORMATION ROOM, REAR OF NIAGARA STREET STATION, BUFFALO RY. CO.

method of cooling employed is very similar to that used with the large transformers at the Niagara Falls end of the line, described above. This building is also provided with switchboard and lightning arresters. The "step down" transformers are each 6 feet 10 inches high, measure 3 feet 11 inches by 3 feet at the base, and weigh about 7,000 pounds each.

It was with the Buffalo Street Railway Company that the third contract was made, and for them the General Electric Company furnished and installed two 500 horse-power rotary converters, with switchboard and instruments, etc. These rotaries will be operated to supply current to the lines of the Buffalo Street Railway Company, or in parallel with the generators now in their power house. The rotaries have six poles and operate at a speed of 500 revolutions per minute. They can be started either from the alternating current or by direct current from the lines to which they are attached.

It is significant of the enterprise of the Niagara Falls Power Company that they have built this transmission line and transmitted Niagara power to Buffalo at this early date, when their Buffalo franchise simply demands that they shall be prepared to sell power in that city on June 1, 1897. The erection of the line in the short period that has elapsed since it was started is work most creditable to all who had contracts. Especially is this true of the work of the White-Crosby Company, who built the pole line, and the General Electric Company.

At present three styles of insulators are on the line. The most noticeable of these, however, is the Niagara type, made by the Imperial Porcelain Works, of Trenton, N. J. The poles used in the construction of the line were furnished by Thomas Barnard, of Lockport, whose men cut about 1,500 of them on the Indian Peninsula, Georgian Bay, while about 1,300 of them were obtained at various points along the Canadian Pacific Railway.

The lightning arresters are of the Wirt type, single pole, and consist of marble upon which are mounted eleven cylinders giving one air gap space 1-32 in. for each one thousand volts with an allowance of 25 per cent., rise in the potential. In the action of the arrester the large metal cylinders serve to chill the arc so that on reversal of the current the arc is extinguished, no dependence being placed upon any non-arcing property of the metal to put out the arc. In order to limit the current on short circuit and thus the heating effect, a special solid graphite rod of low non-inductive resistance is used. The arresters are similar to those used on the Big Cottonwood transmission at Salt Lake City, described lately in The Electrical Engineer, which have effectually protected the machinery in many severe storms.

The first power sent to Buffalo was at a voltage of 11,000, and now that the line is in successful operation, it is probable that the news will soon come that Buffalo is prepared to use more power. The Buffalo franchise calls for the delivery of 10,000 horse-power there by June 1, 1897, should there be a demand for it, and also that the power company shall be prepared to supply 10,000 additional horse-power within each successive year thereafter for four years, as far as the demand may require. This would be a total of 40,000 horse-power, or the total product of eight generators at the Falls.

In preparation for an increased demand for power the Niagara Falls Power Company have decided to install five new turbines and generators in the wheel pit and power house extensions as soon as they are ready for them.

At a recent meeting the company received applications from tenants already on their lands for 5,000 additional horse-power, which is evidence that several of the firms now doing business there intend to enlarge their facilities.

ELECTRICITY VS. COMPRESSED AIR.—ACTUAL RESULTS IN A MINE OF THE COLORADO FUEL AND IRON CO.

BY LEWIS SEARING, M. E., E. E.

THE recent resurrection of compressed air as a possible rival of electricity as a motive power, makes a practical test of both systems under similar conditions of special interest.

Last year the writer was called upon to investigate the compressed air system in operation at one of the largest coal mines of the Colorado Fuel and Iron Company, to ascertain the possible saving that could be made by substituting electricity. The result of the investigation showed such a great possibility for saving by the use of electricity that the Fuel Company decided to have a plant installed. The installation was made under the personal supervision of the writer, and afterwards operated under his direction for over a month, during which time tests were made and the workings of both systems noted.

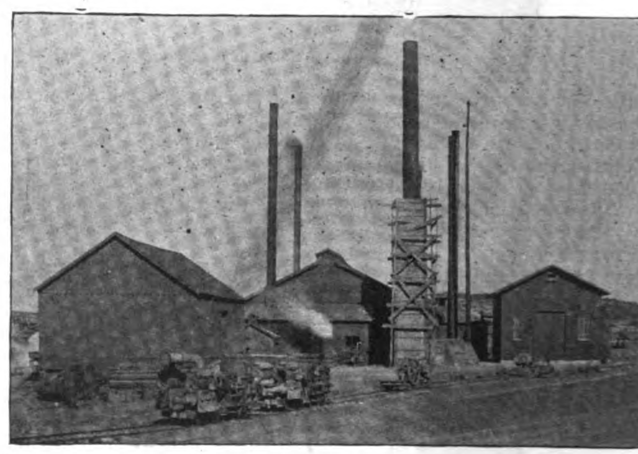
The above-mentioned mine is located at Rouse, Colorado, at an altitude of 6,000 feet. The compressed air plant was employed only for pumping and comprises three Norwalk air compressors, each with 13½-inch high pressure air cylinder, 22-inch low pressure air and 20-inch steam cylinder, all of 24-inch stroke. The air cylinders are water jacketed.

The air receiver stands outside of the compressor house, and is 4 feet in diam. by 12 feet high, having no covering. The air is conducted down No. 1 mine by a 4-inch pipe to a Deane duplex direct acting pump, 18½-inch steam by 9¼-inch water cylinder by 12-inch stroke, located near the face of the slope.

No. 1 mine enters on a slope of an average 5.3 per hundred, continuing downward a distance of 3,300 feet. The workings ramify from this main slope and connect with another mine, known as No. 3, in which there were two small pumps, operated by air. At the time of the test of the air plant these pumps were shut down.

Air is conducted to No. 3 mine by a 4-inch pipe down No. 1 slope about 1,400 feet, from which point a 3-inch and 4-inch pipe crosses to No. 3 through the interconnected workings. The compressors being 400 feet from the mouth of No. 1 slope, the total length of 4-inch pipe to the pump near No. 1 face is 3,600 feet. Pipe to No. 3 has 5,000 feet of 4-inch and 800 feet of 3-inch, a total of 5,800 feet. The air pipes are laid underground as far as the mouth of No. 1 slope, and from there continue down the mine unprotected.

The pump at the bottom of No. 1 slope, on which the test was made, discharged water to the surface through 700 feet of 10-inch pipe and 2,550 feet of 6-inch pipe, the pipe being laid up the slope in a practically straight line. The boilers



POWER PLANT, COLORADO FUEL AND IRON CO., ROUSE, COL.

supplying steam to the compressors consist of a battery of two 60 inches by 16 feet horizontal tubular and six plain cylinder boilers 36 inches by 36 feet, all of which are set in brick. The boiler and compressor house are adjacent to each other, making the connecting steam pipe comparatively short.

The test of the compressed air system was confined to the one pump in No. 1 slope, to obtain the total efficiency between the steam cylinders of the compressors and the water discharge of the pump. This test was not supposed to be an exhaustive one, but made simply to get a good estimate of the efficiency of the system. The amount of water discharged was measured by a weir at the end of the water discharge pipe on the surface. The weir was 16 inches wide, with measuring stake 4 feet up stream.

A pressure gauge was placed on the water discharge pipe at the pump at the bottom of the mine; air pressure was measured at the receiver. Crosby steam engine indicators were attached to the steam cylinders of the air compressors.

Observers were stationed at the various points to take readings. Readings were taken through the day, commencing at 10 a. m. and ending at 5 p. m. At one time in the afternoon one minute readings were taken for ten minutes. At another time one of the compressors was shut down and the pumping done by two compressors, as a check on the indicator measurements.

The results are somewhat surprising:

Average steam pressure	80 pounds
Average air pressure	50 "
Average revolutions per minute:	
Three compressors	64

Two compressors	110
Average gallons discharged by pump per min.	400
Average strokes of pump per minute	176
Average pressure per sq. inch pumped against	120 pounds
Average indicated horse-power at steam cylinders of compressors	312 h. p.

As the theoretical horse-power required to force 400 gallons per minute against 120 pounds is 28, it follows that the efficiency of the system between the points measured is less than 9 per cent!

It will be observed that this is the efficiency of the plant as found under actual working conditions, and includes every loss which may occur between the steam cylinders of the compressors and the water discharge of the pump, and due to wear of apparatus and to inherent and other defects in the system.

As there are many mines in the State that are forced to employ a similar method of pumping under similar conditions, it is fair to assume that the above given efficiency is not far from the average, and that nothing short of a change of system would make a material increase in the efficiency. If we go back of the steam cylinders to the coal pile, we find a still more deplorable state of affairs, for, to operate these three compressors requires eight boilers, consuming 35 tons of coal per day of 24 hours!

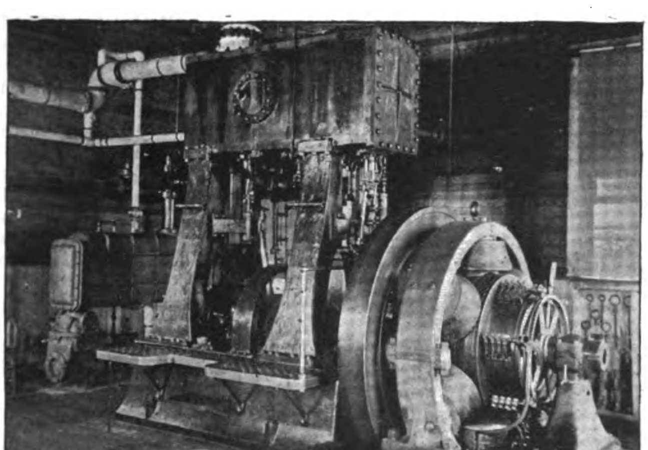
The probable efficiency of the electric plant was estimated as follows:

Direct coupled engine and generator	80 per cent.
Line	90 " "
Motor	85 " "
Pump and gearing	82 " "
Total efficiency	50 " "

With the above efficiency, a 60 horse-power engine would do the work now requiring 312 horse-power by the compressors. Further, assuming the installation of a compound engine, using the mine water for condensing, the total coal consumption per 24 hours would not exceed three tons, making a saving of 32 tons per day.

The order for the electric plant was given to the Denver Engineering Works Company, who were instructed to install sufficient power to operate, in addition to the regular pump, the ventilating fans, screens and shops about the mine, the selection of the machinery being left entirely to the engineers of the Denver Engineering Works. The plant as installed is as follows: The power house is a substantial building of wood, covered with corrugated iron and completely sealed inside. It is large enough for two generating units and condensers, and is equipped with a 6,000-pound capacity, three-motion traveling crane.

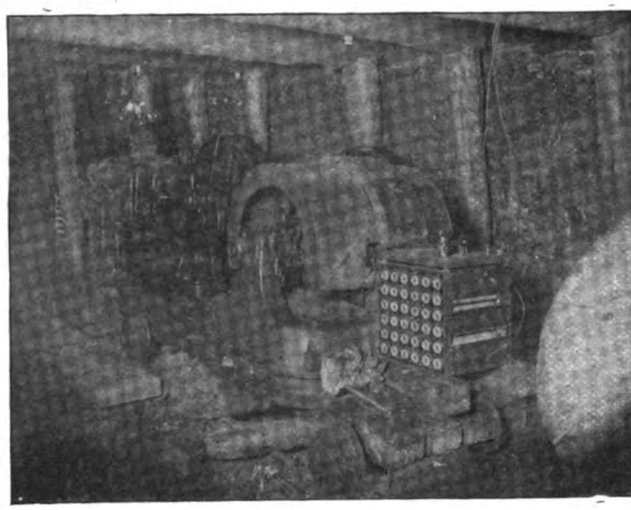
One generating unit only was installed, it being the intention of the Fuel Company to install the second reserve unit as soon as the electric system should demonstrate its success. The engine is a vertical cross compound marine type, and



ELECTRIC GENERATING PLANT, COLORADO FUEL AND IRON CO.

designed by E. F. Williams, of New York City. The cylinders are 11x19x15-inch stroke, developing 150 horse-power, at 250 revolutions, non-condensing. The condenser is a Wheeler surface condenser of the "Admiralty" type. The generator, mounted direct upon the shaft of the engine, has a capacity of 190 amperes and 550 volts. The generator, as well as all the motors, are multipolar machines, built by the General Electric Company. The switch board is of polished slate, and is equipped with the latest improved instruments and safety appliances. To insure absolute protection from lightning, which is very severe in this locality, all circuits are placed underground. The important circuits consist of iron armored and lead cables, while the lighting circuits are made by running rubber covered wire in iron pipe. The mine circuit consists of No. 0000 weather-proof wire, supported on triple petticoat glass insulators and iron-wood brackets, nailed to the mine props.

A 10 horse-power multipolar motor drives two shaking coal screens on the tipple, another 10 horse-power motor runs the



ELECTRIC MINE PUMP, COLORADO FUEL AND IRON CO.

machine shop, and a 25 horse-power motor drives the 20-foot ventilating fan. The installation of these motors displaces a similar number of engines and does away with about 1,000 feet of steam pipe, the condensation in which was no small loss.

There are two small pumps, used as sinking pumps, which are of the duplex type, having water ends, of the Deane Company make, and driven through gearing, by a 15 horse-power motor, mounted on the same frame. The cylinders are 7x 10-inch, and have a capacity of 250 gallons per minute, against a head of 115 feet. The pumps are mounted on a four-wheel truck, and can be moved around as desired. The station pumps, two in number, are double acting duplex, with water ends of Deane Company's make, and cylinders 9½x12-inch, geared to a 110 horse-power motor. These pumps have each a capacity of 600 gallons per minute, against a head of 400 feet.

Shortly after the order was given to erect the electric plant the No. 1 mine encountered an increased flow of water, which flooded the mine, the water coming up the slope a distance of 1,500 feet before it was held in check, and a pump was placed at this point to hold the water until the electric pumps could be put in operation. The water has since been pumped down about 700 feet by the electric pumps, and the work has been as severe a test on the pumps as any skeptic could desire. If the remainder of the pumping is completed with as good success as that already done, it may be truly said that the electric pump has come to stay. For over a month the two small electric and an air pump have been working side by side in an entry 10 feet wide by 5 feet high, with the exhaust of the air pump, into which a stream of water is discharged to prevent it from freezing, discharging so near the electric pump that it was necessary to protect the latter from the water by an oilcloth. This is certainly a good test for the waterproof properties of the motors, which are still doing their work and appear to be in excellent condition.

The average of numerous tests on the two small electric pumps gave the following results:

Average gallons per minute discharged	500
Average pressure at pumps	56.5 lbs.
Average strokes per minute, each pump	172
Average amperes	37
Average station voltage	475
Average indicated horse-power at engine	32.86
Average horse-power at pump discharge	16.4

Efficiency:	Per Cent.
Generator unit, engine and dynamo	71.5
Motor, pump and line	70
Total, from cylinder of engine to water discharge of pump	50

As soon as the first station pump was started and in good running order, tests were made, with the following results:

Average gallons per minute discharged	650
Average pressure at pump	64 lbs.
Average strokes per minute	188
Average amperes	53.5
Average station voltage	550
Average indicated horse-power at engine	53.6
Average horse-power at pump discharge	24

Efficiency:

	Per Cent.
Generating unit, engine and dynamo	73
Motor, pump and line	61
Total, from engine cylinder to pump discharge	44.5

Although the total efficiency with the small pumps is as high as predicted, it is nevertheless true that the engine and dynamo are working at a disadvantage with a load of but 20 per cent. of their rated capacity. In the case of the large pump, the generating unit is underloaded, as is also the pump, which combine to bring the total efficiency below the estimated 50 per cent. When the mine is finally pumped out and all the pumps and motors are running, the generator and engine will have a comfortable load, and it is safe to say that the total efficiency of the pumping plant will then be very close to 60 per cent.

The fact remains, however, that at the efficiency above shown by the present working, the former pumping of 400 gallons per minute against 120 pounds pressure, which equals 28 horse-power, can be accomplished by the electric plant with but 56 horse-power at the surface, instead of 312 as before!

As in the case of the compressed air plant, let us go back of the steam cylinders to the boilers. The engine running the generator was supplied with steam from the battery of boilers operating the compressors, but the piping is so arranged that one horizontal tubular boiler, 60 inches by 16 feet, could be cut off from the rest of the battery and supply steam to the electric plant alone. This was not the regular practice, because all the boilers were required to supply the necessary steam, even when two compressors were running; but on several occasions, when the main steam line was shut down for an hour or more, the electric plant was run on the one boiler, with ease, the safety valve popping more than once during the run, and this with the engine running non-condensing.

Qualitatively speaking, actual results with the compressed air and electric plants, which are the subject of this article, show that the work of pumping calling for 312 horse-power and 8 boilers in the case of compressed air, could be done by electricity with but 56 horse-power and one boiler, disregarding even the use of a compound engine and a condenser.

Further, the writer has no hesitancy in saying that the whole plant of pumps and machinery formerly requiring the eight boilers, taxed to their utmost, can be operated by the present electric plant with but the one horizontal tubular boiler.

MOTORS FOR ROLLING MILLS IN SWEDEN.

An interesting power transmission plant has recently been installed at the Bongbro Iron Works, Sweden. Water power is utilized, the generating plant comprising two 50 horse-power turbines, and three three-phase dynamos. The current is used to drive a plate-rolling mill and a billet mill, to each of which a large motor is connected.

PERSONAL.

MR. W. H. REYNOLDS is the electrician of the Newton Electric Light Company, Sussex County, N. J.

MR. E. S. WHITE, of the Construction Bureau in the City Works Department, has been placed in charge of the subway work in Brooklyn, and has Mr. H. S. Wynkoop, the electrical and gas expert, associated with him. The old commission, which cost the electrical companies $16,000 per year, is dead, but its duties devolve on the Mayor and City Works Commissioner.

MR. A. LANGSTAFF JOHNSTON, C. E., who has been in charge of the construction of the road on Broad street, Richmond, Va., was given a dinner on the occasion of his leaving the city for new work in Philadelphia. The affair took place at the Westmoreland Club, President John Skelton and other officers of the Richmond Traction Company being the hosts. Sixteen sat down to the table, and a most delightful evening was spent. Mr. Johnston was the recipient of many compliments.

TELEPHONY AND TELEGRAPHY.

CASUAL NOTES ON THE USE OF TELEPHONE ELECTION RETURNS.

BY GEORGE HELI GUY.

VARIOUS items have appeared in The Electrical Engineer as to the use of the telephone in delivering election returns, and as to the remarkable success achieved by that new departure. It is hardly yet realized, however, that the service was of a universal character, and that what was enjoyed in New York was but an example of the good work being done all over the country. Hereafter, people will not be satisfied unless at election time they can benefit by the instantaneity of the telephonic service in learning the news.

Many curious and amusing features were developed by the work. One was the fact that the telephone kept on beating the telegraph by an interval of from twenty minutes to half an hour. It was funny to see the district messengers dropping in silly from places served by the telegraph and copying off the bulletins received by telephone; it having been found out all over the city that delay in "relaying" the telephone messages from one circuit to another was simply a condition that did not confront the telephone management, however much it might mitigate against the telegraph.

The center of telephone operations was naturally the telephone building in Cortlandt street, which contains the principal operating room of the long distance company, as well as the main exchange of the local company. An entire floor of the building was given up to the work, and specially equipped for it. Starting from the center hall and extending on each wing were two rows of long-distance telephones, twenty-five in each row. To these were directly connected the long-distance lines from various parts of the country, and lines to police headquarters, the various newspaper offices, and committee headquarters. One set of telephones was used exclusively for receiving the news and the other for forwarding it on to different points. As each piece of news reached the receiving operator over his line, the bulletin was written out by him and taken by a messenger to the typewriting room, which was situated at the junction of the two lines of telephones. Here the message was copied out on the typewriter in manifold, and immediately distributed by another force of messengers to the outgoing telephones. It will be seen that a minute or less would suffice for this. A number of these outgoing instruments served only the local distributing system in New York City. In one room eight instruments served groups of four receiving telephones specially equipped at the various hotels and clubs in the city which had previously arranged for the service. Other telephones were connected to lines run to the different branch exchanges throughout New York, from which a redistribution of the bulletins was made to subscribers and to general enquirers over the telephone. One interesting feature of this series of instruments was a section devoted to lines running directly to the houses of some of the prominent candidates in the campaign, and to those of other eminent men particularly interested in the result of the election. One of these ran to the Long Island residence of a well known ex-Cabinet Minister, who was giving a large dinner party on Tuesday evening. He was thus able to entertain his guests throughout the evening with the earliest election news from all over the country. Even while the party was at dinner, the more important bulletins were read out from time to time.

In one room of the telephone building was a large staff of editors engaged in comparing the returns with those of the election of 1892. One of the most striking points of this extemporized service was its remarkable smoothness and efficiency. Everything worked with the steadiness and vim of a well tried and long systematized plan. Moreover, all this time the regular service of the exchange was going on without the slightest interference, three floors above. The staff engaged in the temporary work on the fifth floor numbered about 150. They were on duty from 5 o'clock in the evening, with relays, to 2 o'clock on Wednesday morning.

At the Thirty-eighth street exchange some fifty telephones, connected to the switchboard of the station in the same manner as the regular subscribers' lines, utilized the bulletins as fast as they came in over the direct line from Cortlandt street. When a subscriber from any part of the system called up for information regarding the returns, he was connected with one of these special instruments and his inquiry was attended to. The business here was very heavy, as the station is in the very center of the hotel and club district. About 1,500 calls were thus disposed of. At many of the up-town hotels, and

especially at the Windsor, large crowds waited eagerly for the publication of the telephone bulletins. At the Manhattan Club there were two lines of bulletin posters, one line containing the telegraphic dispatches strung on one side of the room, and another line opposite carrying the telephonic intelligence.

The grouping of a number of instruments together for attachment to one telephone at the exchange end gave rise to some amusing experiences. On one of the circuits was a piano factory. To while away the time between the bulletins, the proprietor swung two pianos into position, and entertained the rest of the people on the circuit with operatic selections and inspiring national airs. In another place, one of the participants in the service was a young lady, who from time to time discoursed music on the mandolin. The general tendency of those on the line was to become quite friendly and communicative, and frequently discussions of the situation were carried on and notes were compared on what was going on in the street immediately under the windows of the respective subscribers. Another point of great interest was brought out on one uptown circuit. As almost every man of the group happened to be well posted about some section of the country or had made a study of the bearing of many of the local returns, the telephonic bulletin was instantly supplemented by some special information for the general benefit. A comparison would be made with old election returns, or incidents in a recent visit to the section concerned would be described, so that the telephone returns were made vastly more suggestive than any telegram sent to an isolated individual could be. For instance, when the returns came early in the evening from Marion County, the interpretation of one of the parties on the line was that the State of Indiana would be carried for McKinley by fifteen to twenty thousand, at least, because a complete reversal of some fourteen thousand votes given for Cleveland in 1892 was indicated. In order to obviate the trouble of holding the receiver constantly to the ear, the regular telephone headgear was supplied to every one who wanted it. Sometimes, however, the listener would get tired and divest himself of his receiver for half an hour. When he readjusted it, as likely as not a member of his group, disguising his voice to resemble that of the "central," would interject some astounding information as to phenomenal and unheard of Democratic gains in a solid Republican State. In apartment houses particularly the telephonic delivery of the returns was much appreciated by the female residents, for the reason that they were no longer left behind by their husbands and brothers, and had no need to go out and expose themselves to the pushing and surging of wild crowds on the streets and squares. In one large house, a billboard, draped with two American flags, was put up on one side of the entrance hall. The pay station telephone alongside was equipped with an operator, and all the returns, as they came in—sometimes at the rate of two or three a minute—were quickly taken down on large blanks provided for the purpose, read out, and fixed upon the board. A great many of the ladies living in the house joined the listeners. The audience, which changed and grew during the evening, was delighted with this new form of politico-social function, and the impromptu telephone party was voted a tremendous success.

What was done in New York is typical of what was done throughout the country. One instance of the appreciation of the public will suffice. In Philadelphia, Dr. S. M. Plush sent out 5,000 postal cards to the subscribers asking them if they wished the service, which would cost them nothing. Fifteen hundred availed themselves of it, and they have not yet ceased sending in their thanks and congratulations.

WHICH EAR DO YOU LISTEN WITH?

A Berlin scientist has ascertained by experiment that a number of persons who use the telephone habitually hear better with the left ear than with the right. To educate the right ear to the same point he recommends holding the instrument in the right hand half the time. The common practice of the telephone companies is to place the receiver so that it will be applied to the left ear.

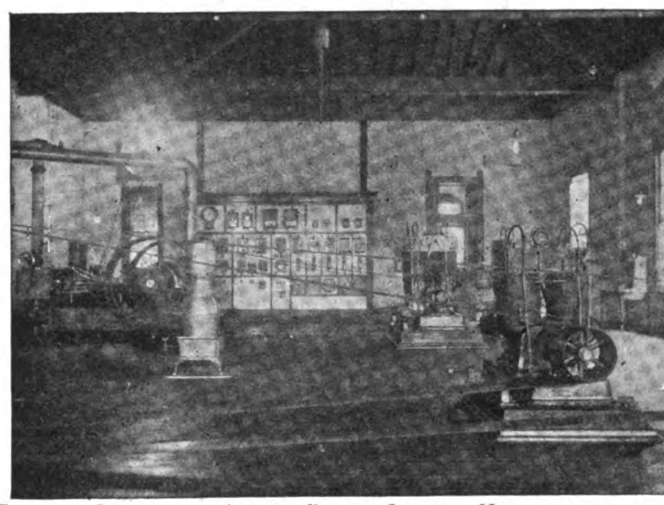
MIDNIGHT SPECULATION BY CABLE.

During election night, one firm of Wall street brokers arranged matters so that New Yorkers and others could anticipate the course of the local markets by speculating on the London exchange in advance. A private wire of the Western Union Telegraph Company furnished election returns and the office was in close communication with the London stock market by means of another private wire put in by the Anglo-American Cable Company. In this way the customers and friends of the firm were able to do early stock trading in the London market on the basis of the election returns, the firm having made arrangements for dealings on the London Stock Exchange with three of the largest London arbitrage brokers. The execution of orders on the London Stock Exchange begun about 4:30 o'clock Wednesday morning, or at 10 a. m. London time, when the Exchange on the other side of the Atlantic opens. The close of the London Exchange occurs shortly after 11 o'clock, New York time.

ELECTRIC HEATING.

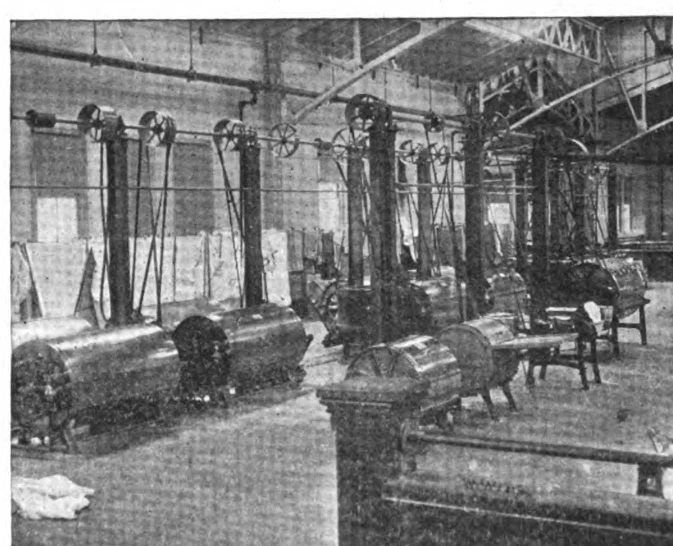
ELECTRIC LAUNDRY PLANT AT THE CENTRAL INDIANA HOSPITAL FOR THE INSANE.

EVERY day new applications of electricity develop and bring us nearer to the time when the most unpleasant and arduous occupations will become a pleasure to conduct. No new plan of electrical development is doing more to assist in bringing about this condition than that of electric heating. The electrical equipment of the Central Indiana Hospital for the Insane, at Indianapolis, Ind., is a striking example of one application where great economy of labor has been achieved



Electric Light and Power Plant, Indiana Hospital for the Insane.

and the conditions surrounding the operator vastly improved. The equipment of the laundry with electrically heated sad irons has reduced the number of employés at the ironing tables nearly one-half. The reasons why such results are

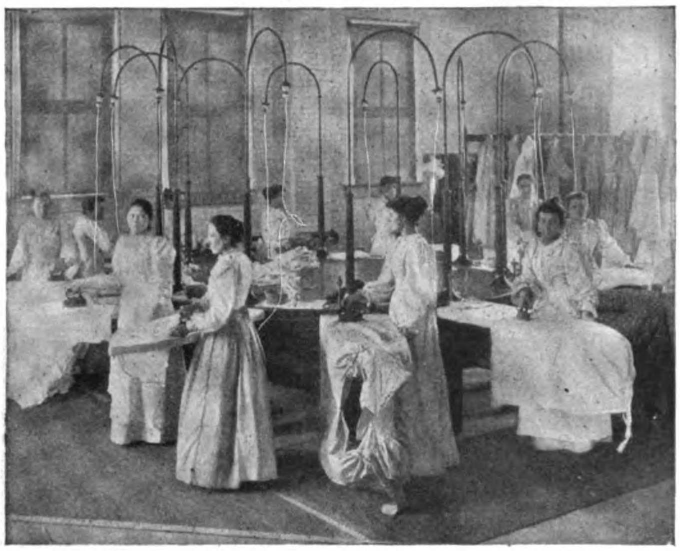


Laundry Machinery Driven by Electric Motor, Indiana Hospital for the Insane.

possible, are that the electric irons are constantly supplied with a uniform amount of heat, nearly all of which is absorbed by the work, and, by reason of the constant supply,

every rub is equally efficient; there being no appreciable heat radiated from the iron, it is apparent that in a room where the temperature can be regulated and there is no vitiation of the atmosphere due to combustion, much more work can be accomplished.

The complete electrical plant has been in full operation for about a year. It was planned and built with a view to embodying all features which would contribute to and produce an up-to-date and consequently most efficient combination.



ELECTRIC SAD IRON INSTALLATION IN INDIANA HOSPITAL FOR THE INSANE.

The equipment consists of three Phœnix boilers with a total capacity of 450 h. p. There are two 125 h. p. Phœnix center crank, high speed engines; each engine belted to two 45 k. w. Edison type, bi-polar compound, 110-volt generators. One 65 h. p. Phœnix engine is belted to one 25 k. w. generator of the same type, and one 20 arc light Edison generator. The illustration shows a partial view of the engine room. The three-wire system is used for all incandescent and power distribution, and all mains distributing to the different buildings for both arc and incandescent work are underground.

In addition to the usual switchboard equipment, all mains have separate amperemeters and voltmeter connections. The buildings are wired for 3,020-16 candle-power incandescent lamps. The twenty arc lights are used to light the campus, groves and drives; the grounds being very extensive, comprising several hundred acres.

One 3-h. p. motor is belted to an exhaust fan in the generator room. One 25 h. p. motor is belted to a counter shaft, driving the line shaft running twelve steam washing machines, two sterilizing machines, four centrifugal extractors, two starching machines and one tumbling machine, all made by the American Laundry Machine Company; and also driving one large Troy mangle, skirt ironers and one or two smaller machines. In the laundry there is placed a handsome switchboard, which is shown in the illustration, equipped with knife switches for controlling the supply of current to thirty-two laundry irons; also the automatic motor starter and the motor and main line switches. The equipment for electric sad irons is unique.

In the illustration is shown one of the tables arranged for twelve operators. All tables are of the same dimensions. The detailed description is of interest, bringing out as it does an arrangement, possible only with electric irons, which provides ample room for each operator, and yet permits the grouping of a large number in a comparatively small space. Each table is constructed of hard wood, the central portion being 10 feet in diameter and 3 feet high. From the periphery of the central section and 2 inches below the level of the same, branch out twelve ironing boards or tables, each 4 feet 6 inches long by 18 inches wide. Around the edge of the central section are placed twelve cast iron pedestals, about 2½ feet in height, from the top of which extends a section of ¾-inch iron pipe bent over, in the form as shown in the illustration. The wires are brought to the tables through conduits under the concrete floor and distributed beneath the tables to each upright, through which they pass to porcelain sockets at the ends of the bent pipes. In each socket is inserted a fusible plug attached to a flexible cord leading to the iron, depending in such position that it is always at the right and back of the operator. Small knife switches are conveniently placed near the base of the pedestal for the use of each operator. The clothing to be ironed is deposited on the center table, which is within easy reach of all.

The laundry is pleasantly situated in a special building, built for this purpose and is bright, and is clean and comfortable, the temperature at the ironing table being never more than 75 degrees F., except when the outside atmosphere is higher. The operators are neat and fresh looking, as would be expected from their surroundings.

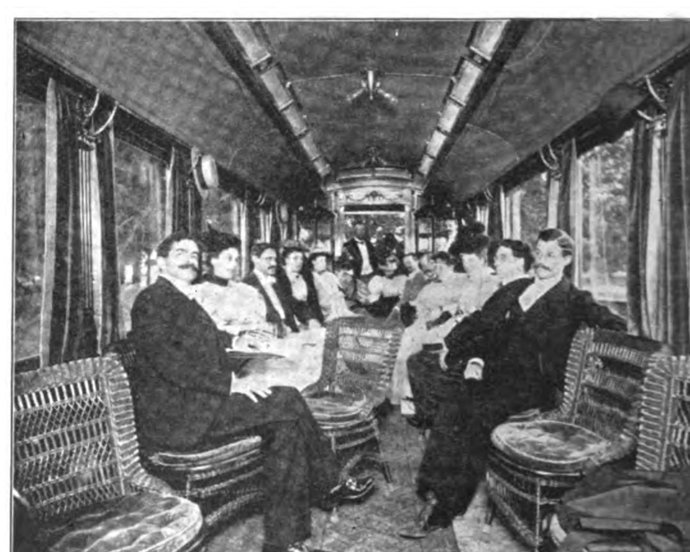
Only one-half of the number of employés are now used, that were required in the old laundry using irons heated with natural gas. This electric ironing installation was made by the American Electric Heating Corporation, of Boston, through their Chicago representative, Mr. F. P. Luther. It is only necessary to realize that one of these tables can easily be placed in a room 20 feet square and provide accommodations for each operator in every way far better, as to light, temperature, cleanliness and freedom of movement, than would be possible by any other means. The saving in cost of labor alone, natural gas being used for fuel in generating electricity, is more than sufficient to cover the total cost of the new method.

Dr. George F. Edenharter, superintendent of the institution, is a progressive physician, whose success in administering its affairs has been conspicuous and the Board of Control of the institution, consisting of J. S. Carson, John Ostaman and B. H. Davis, have always been ready to second his efforts. Much credit is due to E. E. Frost, chief engineer, for the well arranged and well ordered machinery plant, and for the electrical work, including the design of the table, the arrangement of the stands and many unique features, Joseph H. Stewart, the electrician, is responsible. He is enthusiastic and untiring in his efforts to extend the usefulness of the department which he controls and he is much appreciated by the officers of the institution.

ELECTRIC TRANSPORTATION.

THE "DRY GOODS TROLLEY" IN BROOKLYN.

THE Brooklyn Heights Railroad Company have recently established parlor car service between the village of Flushing and the city of Brooklyn. Flushing has a population of between nine and ten thousand and is something more than eleven miles distant from Brooklyn proper. The cars have been in service for a little more than three weeks, and already the patronage they have secured is abundant proof that the action of the railway company is appreciated by the ladies of Flushing. The service is particularly for shoppers, who wish to reach the large dry goods stores in Brooklyn.

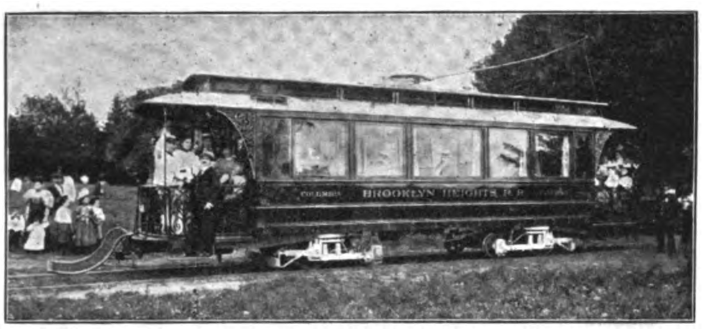


INTERIOR VIEW OF BROOKLYN DRY GOODS OR PARLOR CAR.

The cars run twice each week, on Tuesdays and Fridays, making two round trips on each of these two days, leaving Flushing at 9:30 in the morning and again at 2 o'clock in the afternoon, and returning from Brooklyn at 12:15 and 4:45 p.

m., in the first case reaching Flushing in time for a late lunch and in the second place returning the passengers in good time for dinner.

The Brooklyn treminus is at Flatbush avenue, which is about the uptown boundary of the important drygoods trade of the city. The regular parlor cars of the road are used. They are equipped with easy chairs, upholstered in green, and the trip includes the services of a porter. No stops are made between the two points, so that all the privacy and seclusion of a well-appointed parlor car is given the patrons of this up-to-date surface road. The usual fare from Flushing to Brooklyn for a round trip is twenty cents, but on the parlor cars an ad-



EXTERIOR VIEW OF BROOKLYN DRY GOODS CAR.

ditional fee of only 15 cents is charged, which counts but little as compared with the comfort of traveling. The arrangement prevents overcrowding, of course, and adds a degree of comfort and elegance to this method of traveling, which the ordinary trolley car does not seem to possess. The parlor cars of the Brooklyn Heights Railroad are a feature of the road in themselves. Three of them are now in service, two of them, the Columbia and Amphion, being built by the Barney & Smith Co., of Dayton, while the Montauk was built by J. G. Brill & Co., Philadelphia. The cars are 35½ feet in length over all and are fitted up in the highest type of modern street car manufacture. The illustrations herewith show respectively the interior and exterior of the car Columbia, from which a fair idea of their beauty may be gathered.

THE INSTITUTE DISCUSSION ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.—II.

BY CHARLES K. STEARNS.

THE information obtained from the operation of the Nantasket electrical line, during the summer of 1895, was more or less of a general nature, as the chief object in view from the standpoint of the railroad officials was to demonstrate that an electrically equipped road could be operated as satisfactorily in regard to the facility of handling large numbers of passengers on time, as a steam road.

This point was proven beyond doubt, as the railroad officials have expressed themselves as satisfied after observing the ease with which the trains carried the large number of people the boat line brought to the trains at Pemberton, the extreme end of the line.

The cost of operating this line during its first season was roughly obtained, but the experimental nature of the car equipments was such as to render any figures as to the cost per train mile anything but accurate.

The equipment in the station is no doubt well known; suffice it to say, that there were installed two 500 k. w. direct connected generators wound for 600 volts potential; two compound condensing Green engines of about 1,000 h. p. capacity each, and eight return flue boilers, 18' x 72" diameter.

The train schedule of July, 1895, called for 150 trains per week day, or an average of 148.1 trains per day, including Sundays, and in 1896, 66 trains per day, or, including Sundays, an average of 68 trains per day. In 1895 these trains consisted of a sufficient number of cars to accommodate the people, but in 1896 the trains were limited to two cars, a motor car and trailer. To accommodate the passenger traffic, extra trains were made up and run between the regular scheduled trains. A fair average on Sundays would be about 150 trains, and week days 75 trains per day. This partially accounts for the difference in the coal consumption in 1895 and 1896, although in 1896 the engines were run condensing, while in 1895, non-condensing.

The line operated in 1895 was 6.86 miles of double track, equipped with special trolley wire, and in 1896 the same length of trolley line, with the addition of 3.64 miles of double track equipped with the third rail. The actual rail laid is about three miles double track, allowing for omissions of the rail at the crossings and stations. The distance from the power station to the end of the third rail is 4.75 miles, and to the end of the trolley line 5.75 miles.

The following table, although incomplete, gives some idea of the operation of the power station during July, 1895 and 1896:

	July, 1895.	July, 1896.
Hours run	605⅛	546¼
[1] Ave. elec. h. p. per nour...	245	349'/₁₀
Pounds coal burned	629,575	571,100
Coal per e. h. p. hour.......	4.24	68
Average trains per day	148.1	2.99
Average cars per train	2.1	2
Maximum cars per train	7	2
Train miles	32,803	44,173
Passengers	267,143	....
Tons passengers	18,700	....
Tons dead load	162,089	....
Tons total load.............	180,789	....
P. c. pay'g load to dead load.	10.2	....

In regard to the third rail equipment, it must be remembered that this was in the nature of an experiment, and several defects have been noted, which no doubt will be corrected in the future.

The rail itself is about 100 pounds section, rolled in the form of an angle of 110 degrees, with a standard rail top or surface for the shoe. This rail, as originally installed, was bonded wth cast copper bonds, and further supported by insulating blocks placed 7½ feet from each end. This was found insufficient, and fish plates were put in with a flexible copper bond and the rail supported by insulating blocks placed as near the ends as possible, with an additional block in the center to prevent vibration. These blocks are about 6 inches high, and fit the angle of the rail. This rail is not continuous, the grade crossings, of which there are several, being omitted, and the train running by momentum over them. This was necessary, as the width of some of these crossings is considerably greater than the length of the motor car. At the stations, also, the third rail is omitted and the overhead wire used. The installation consists, therefore, of a combination of third rail and overhead wire, the train starting out of the stations by the overhead wire and trolley, and running between stations by the third rail and shoe.

I cannot say that this plan is very satisfactory, particularly at night, when the different crossings are emphasized by darkness in the cars. The third rail, as now laid, is alive the entire length. It seems to me a question as to the advisability of operating a line with a 500-volt difference of potential in a position where there is liability of careless persons coming in contact with it. One accident has occurred and, although I understand legally, the public are not allowed on the right of way, the liability occurs of careless parties or workmen coming in contact with the two rails.

The regular steam rail used is 6 inches high. The third rail is 7 inches from the tie. This allows a clearance of 2½ inches from the pilot of a regular locomotive, provided this pilot is up to standard. There have been several cases where a locomotive pilot, chain or brake rod on a steam train running over the third rail section, has come in contact with the third rail and caused a short circuit of such length that it was found impossible to keep the current on this section of the electric branch. This section, I will state, is connected with the power station switchboard by a separate feeder and circuit breaker. In these cases the electric trains have come to a standstill until the steam train was off the section.

From these considerations it seems advisable to adopt a system where the conductor, if of the third rail type, is alive only at points where it is actually used, or at least divide the line into blocks, so that one train will be in a block at a time.

The insulation resistance of the pole line in 1895 was 140 ohms, or an average leakage of 4.7 amperes. This is on a line consisting of 577 Georgia pine poles, the trolley wire being fastened to angle iron cross-arms, which are bolted to the poles by two ¾-inch through bolts. No insulators are used. On the third rail there are about 3,500 points of support. I am sorry to say that I have been unable to obtain information as to the leakage on the third rail under varying weather conditions.

[1] During July, 1895, power was furnished by the station to operate the Hull Street Railway, the average of which was 30 h. p. by separate wattmeter. Consequently, the average power for the railroad was 215 h. p. 349 h. p. in 1896 includes about 40 h. p. furnished the Braintree & Weymouth Street Railway, so that the power for the railroad amounts to 309 h. p.

A serious objection to the present installation of the third rail is the connection by lead covered cables between the ends of the rails at crossings and stations. The surface leakage from the rail to the lead covering must be considerable, although I am not aware as to whether it has been measured or not. The outside covering of the cables has been found to be very sensibly alive.

Aside from the use of the third rail or trolley wire I believe that more uniformity of load in the station should be obtained by the use of storage batteries either on the cars or in the station. The extreme demands for power on the line, when seventy-five trains were in service, and these trains heavy, were very noticeable compared with the service of 150 trains per day in July, 1895.

In conclusion, it seems very desirable to put in a third rail in preference to the overhead trolley wire in such a manner as to avoid any liability of injury from accidental contact with the rail. In other words, put in the rail in blocks and then only such part as is in actual use to be active. A method of this kind would reduce the leakage to a minimum and place the electric road on an equal footing with the present block system of steam railroading.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Electro-Physics:

ON THE ACTION OF LIGHT ON THE SPARK DISCHARGE.—By E. Warburg. Author discusses the work of Herz, who showed that an electric arc kept about ¼ meter away from the secondaries of an induction coil, will help in producing a discharge in the secondary, even when the terminals are so far apart that under ordinary conditions such a spark can no longer be produced. Author has not only repeated these, but has also added a series of additional experimental data in the same line of work.—"Annal. de Phys. & Chim.," No. 9, '96.

TO THE DEMONSTRATION OF MUTUAL INFLUENCE OF TWO SPARK GAPS.—By Ignaz. Klemencic. An arrangement is illustrated and explained by means of which the mutual influence of two secondaries of two induction coil can be demonstrated without much manipulation.—"Annal. d. Phys. & Chim.," No. 9, '96.

EXPERIMENTAL RESEARCHES WITH GEISSLER TUBES.—By R. W. Wood. These researches include the determination of temperature in the Geissler tubes. Author explains his instruments and methods.—"Annal. d. Phys. & Chim.," No. 10, '96.

ELECTROSTATIC DEFLECTION OF CATHODE RAYS.—By G. Jaumann. That the electrostatic deflection exists is shown by several conclusive experiments. Thus an additional property of the cathode rays is established.—"Ann. d. Phys. u. Chemic.," No. 10, '96.

ELECTRIC CURRENTS THROUGH AIR AT DIFFERENT DENSITIES.—By Lord Kelvin, J. T. Bottomley and Magnus Maclean. Paper read before the British Assoc. An account of measurements of electric currents through air at different densities down to one five-millionth of the density of ordinary air. These experiments were made with the Wimshurst machine, and the general conclusion reached was as follows: If a curve be drawn for a constant difference in potential, with air densities as abscissæ and currents as ordinates, we find the curve rising as the air density is diminished to about 1-1,000 to 1-1,500 of the ordinary density, then falling again as the density is still further reduced to about a five-millionth of ordinary density. Lond. "Elec. Eng'r.," Oct. 9, '96.

Electro-Chemistry:

RESISTANCE OF ELECTROLYSIS.—By Max Wien. Dynamometer tests have shown that resistance of electrolytes under the influence of the alternating current increases; that is, it appears greater than what could be expected from the same dimensions and the same conductivity.—"Annal. de. Phys. & Chim.," No. 10, '96.

Railways:

LIVERPOOL OVERHEAD RAILWAY.—By S. B. Cottrell. Paper read before the Brit. Assoc. Besides the historical development of the enterprise, details of the electric installations are given, the essentials of which are as follows: Trains consist of two carriages, each 45 feet long, 8 feet 6 inches wide. Each car contains seating capacity for 16 first class and 41 second class passengers. The tractive force of each motor at rim of wheel, 2 feet 9 inches diameter, with 120 amperes, is about 1,790 pounds. A train fully loaded weighs 38 tons, of which motor equipment is about 6½ tons. Several tables accompany the article, which indicate the costs per mile, etc. Lond. "Elec. Eng'r.," Oct. 16, '96.

JUNGFRAU MOUNTAIN ELECTRIC RAILWAY, SWITZERLAND.—Details of one of the most remarkable electric railway enterprises yet proposed. "Elec. Eng'r.," Nov. 18, '96.

ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.—Topical discussion before the Am. Inst. of Elec. Eng'rs. Discussion opened by Dr. Chas. E. Emery, whose remarks appear in "Elec. Eng'r.," Nov. 18, '96.

A MODEL ELECTRIC RAILWAY PLANT.—Some details of the Fair Haven and Westville road, with views of power house, branches of road and a diagram showing the dynamos and connections of the wires in the power house. "Scient. Am. Suppl.," Nov. 14, '96.

ELECTRIC RAILWAY IN FRANKFURT-ON-THE-MAIN.—An electric road is proposed, where the company which is to undertake the running must take the alternating current from the city and use rectifiers for generating the direct current. "Elektrotech. Zeitsch.,' Nov. 5, '96.

Lighting:

FREE SUPPLY OF INCANDESCENT LAMPS TO CONSUMERS.—By Alfred H. Gibbings. Author shows, first, the reasons why the supply of lamps should be in the hands of the corporation, apart from the question of free distribution; second, the disadvantages arising from the sale of lamps, and, third, the basis of supply, and the financial aspect of providing lamps without charge.—"Lightning," Oct. 22, '96.

PROPOSITION OF THE COMMITTEE ON INCANDESCENT LAMP STANDARDS.—The rules laid down are for 60-70 and 95-125-volt for 3-4 watts per candle, and for 10, 16, 25 and 32 candle-power lamps. "Elek. Zeitschr.," Nov. 5, '96.

Magnetism:

COMPARISON AND REDUCTION OF MAGNETIC OBSERVATIONS.—Report of the committee to the Brit. Assoc. The report deals in detail with the so-called "non-cyclic" effects during the years 1890-1895. Lond. "Elec. Eng'r.," Oct. 23, '96.

Measurements:

REPORT ON THE CALIBRATION OF THE SCIENTIFIC INSTRUMENTS OF THE LATE DR. JANLE.—By J. D. Charlton. The results obtained by the mechanical method of determining the heat equivalent differs from the electrical method. Author believes this error to be due to an error of determining the current strength.—"Proc. Roy. Soc.," 59, pp. 345-360; note in "Wiedemann's Beiblätter," Vol. 20, No. 9.

Miscellaneous:

ELECTRIC CARRIAGES.—The advantages of the new Jeantaud carrage are described. "L'Ind. Elec.," Oct. 25, '96.

Roentgen Rays:

WAVE LENGTH OF ROENTGEN RAYS.—By L. Fromm. Author, judging from experiments carried out by himself, thinks that the rays are about .000014 mm., or 15 times smaller than the shortest ultra-violet wave.—"Ann. d. Phys. u. Chem.," No. 10, '96.

Storage Batteries:

GULCHER ACCUMULATORS.—Special methods are employed to lighten the battery as much as possible. The capacity per kilogram of positive electrode is about 44 ampere hours. "Elektrot. Zeitschr.," Oct. 29, '96.

STANDARD CELLS.—By Henry S. Carhart. Referring to two papers which have recently appeared, one by Ayrton and Cooper, another by W. Hilbert, Prof. Carhart points out that these writers have brought out points, which are known for several years, and he gives his various sources as well as dates under which he himself has published these data. "Elec. World," Nov. 14, '96.

Wiring:

INSULATED WIRES AND CABLES.—By J. Draper Bishop. The first of a series of articles treating construction and design, insulation efficiency and defects.—"Elec. World.," Nov. 14, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 10, 1896.

ELECTRIC BURGLAR ALARM. C. Coleman, Chicago, Ill., 570,906. Filed Dec. 21, 1895.
Embodies a meter electrically connected with the main circuit and adapted to complete the alarm circuit upon a variation in the condition of the main circuit.

ELECTRIC ANNUNCIATOR. J. Stamm, Stuttgart, Germany, 570,967. Filed July 10, 1895.
Composed of central station, push button, wire connections, a series of electromagnets, and electromagnetic circuit closers adapted to swing the electromagnets in groups into the circuit.

ELECTRICALLY CONTROLLED DERAILS FOR RAILWAY CROSSINGS. J. P. Coleman, Edgewood Park, Pa., 571,107. Filed June 1, 1896.
Means for locking the switches and signals of a single track railway grade crossing.

Batteries, Secondary:—

ELECTRIC STORAGE BATTERY. T. W. Allan, London, England, 571,059. Filed Feb. 19, 1896.
An accumulator plate comprising a rectangular frame having integral inwardly extending flanges, and a set of stays upon each face of the frame having beveled edges, perforations in three of its edges and in the flanges, and having one edge left open for the removal of the core in casting.

ELECTRODE FOR SECONDARY BATTERIES. H. Woodward, Toronto, Canada, 571,143. Filed March 23, 1896.
Comprises a perforated tube; a central ribbon of lead forming a core; a filling of pellets or red oxide of lead, and plates dividing the filling of pellets into a series of layers.

Conductors, Conduits and Insulators;—

ELECTRIC LIGHT ATTACHMENT. J. H. Rusby, Nutley, N. J., 571,248. Filed April 30, 1896.
Insulator attachment for suspending an electric lamp from a ceiling or wall.

ELECTRIC WALL BOX. W. F. Bossert, Utica, N. Y., 571,297. Filed Aug. 3, 1896.
Consists of a wall box having openings adapted to receive electric conduits, plug plates wedged in the openings and substantially coinciding with the exterior and interior surfaces of the walls of the box.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. J. F. Kelly and C. C. Chesney, Pittsfield, Mass., 571,270. Filed July 30, 1896.
A system of distribution in which the electromotive force of the current in the line can be varied so as to make up for line losses and the like without affecting a common magnetic field of the generator or the system as a whole.

SYSTEM OF ELECTRICAL DISTRIBUTION. C. C. Chesney and J. F. Kelly, Pittsfield, Mass., 571,300. Filed Dec. 3, 1895.
Similar to above.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE G. E. Dorman, Chicago, Ill., 570,914. Filed Feb. 4, 1896.
An armature comprising a wheel having a rim and a central hub and being provided with slots which extend from the edges to the spokes, a series of projecting arms of laminated iron fastened to the rim and separated by spaces which register with the slots in the rim, said projecting arms each composed of a series of insulated plates of iron.

ELECTRIC MOTOR. G. R. Green, Philadelphia, Pa., 571,043. Filed March 7, 1896.
Oscillating motor.

FIELD MAGNET POLE. J. J. Wood, Fort Wayne, Ind., 571,181. Filed Sept. 8, 1896.
A laminated field pole adapted at one end to be embedded in a cast yoke made of laminæ having sides of unequal length at their embedded ends, and reversed at intervals to form oblique ribs projecting to alternately opposite sides.

MAGNETO-GENERATOR. J. C. Francis, New York, 571,305. Filed Jan. 2, 1896.
The combination of an electromagnetic generator, of the contacts, the contact lever, and a slack chain arranged to operate the lever when the chain is tightened.

DYNAMO ELECTRIC MACHINE. R. Lundell, Brooklyn, N. Y., 571,310. Filed Oct. 7, 1895.
The field magnet cores and pole pieces are so divided and arranged that the magnetic reluctance is caused to increase in the direction of rotation of the armature.

Electro-Metallurgy:

ELECTROLYSIS OF IRON. A. S. Ramage, Cleveland, O., 571,956. Filed Nov. 4, 1895.
A compound for use in electrolyzing iron composed of sulfate of iron, sulfate of soda, sulfate of ammonia, in suitable proportions, with water to form a solution substantially 20 per cent. strong.

Lamps and Appurtenances:—

ELECTRIC LAMP. R. M. Hunter, Philadelphia, Pa., 571,123. Filed Oct. 5, 1893.
A focussing arc lamp.

ELECTRIC ARC LAMP. H. R. Palmer, Norfolk, Va., 571,137. Filed March 25, 1896.
Employs an adjustable stop or cut-out, whereby the descent of the upper carbon will be arrested, and the light may be extinguished at a determined line.

Measurement:—

ELECTRIC METER. C. Wirt., G. R. Green and H. Burger, Philadelphia, Pa., 571,032. Filed March 7, 1896.
A solenoid instrument.

ELECTRIC METER. H. Burger and W. H. McFall, Philadelphia, Pa., 571,036. Filed March 7, 1896.
An oscillating cam driven by a motor, the working surface of the cam being constructed so as to move the register actuating device in the other direction with a gradually decreasing speed of movement.

ELECTRIC METER. H. Burger and W. H. McFall, Philadelphia, Pa., 571,037. Filed March 7, 1896.
Details of the above.

Miscellaneous:—

ELECTRICAL SELF-PLAYING PIANO. G. H. Davis, New York, 570,911. Filed Sept. 14, 1895.
Relates to music sheet holder.

DETENT FOR RATCHET WHEELS. W. D. Marks, Philadelphia, Pa., 571,050. Filed Aug. 22, 1896.
Consists of a ratchet wheel, a spring detent therefor and an adjustable weight for regulating the pressure of the detent.

COMPOSITION OF MATTER FOR MANUFACTURING CALCIUM CARBID. H. Eldridge, D. J. Clark and M. W. Wambaugh, Galveston, Tex., 571,084. Filed April 30, 1896.
Composed of quicklime, carbon, soda and borax.

ELECTRICAL DISCHARGE DEVICE. C. E. Skinner, Pittsburg, Pa., 571,099. Filed May 21, 1896.
Electrodes for spark discharge.

BLACKLEADING MACHINE. W. H. Nichols, Boston, and R. Stephenson, Quincy, Mass., 571,199. Filed Jan. 27, 1896.
Relates to machines for applying powdered plumbago to wax molds prior to the electrotyping process.

ELECTRIC HEATING APPARATUS. A. E. Appleyard, Natick, Mass., 571,257. Filed Jan. 30, 1896.
Comprises an electrical resistance contained in a space or chamber between an outer and inner tube located within a water receptacle.

ELECTRIC GAS LIGHTING DEVICE. E. Schmidt, Berlin, Germany, 571,288. Filed Aug. 1, 1896.
Consists of an electromagnet having an armature consisting of two independently movable members, a gas cock operatively connected to one member and an igniting device operatively connected to the other member.

Railways and Appliances:—

ELECTRIC LOCOMOTIVE. J. F. McLaughlin, Philadelphia, Pa., 570,945. Filed June 24, 1891.
An electric motor composed of two part armature and field magnet, the latter completely inclosing the former; and a two part friction clutch for connecting the armature with the car axle.

TROLLEY FOR ELECTRIC RAILWAYS. P. C. Macevoy, Brooklyn, N. Y., 571,092. Filed Dec. 10, 1895.
Embodies spring operated guide arms connected with the frame, adapted to be thrown upwardly when the pressure on the trolley wheel by the conductor wire is removed.

ELECTRIC RAILWAY TROLLEY. H. D. Hinckley, Hartford, Conn., 571,120. Filed Aug. 12, 1895.
Means whereby the trolley pole will be normally maintained in a working position, and whereby a retractive movement of the trolley pole will be automatically effective when the pole is thrown out of its working position.

STATION INDICATOR. D. E. Connor, Covington, Ky., 571,301. Filed June 29, 1896.
Details of construction.

Switches, Cut-Outs, Etc:—

AUTOMATIC SAFETY CLOSER. W. L. Pratt and F. E. Ripley, Adams, N. Y., 570,955. Filed Jan. 20, 1896.
Comprises a hinged arm carrying the loop connections, the arm being held normally in circuit by a fuse wire, an electromagnet and an armature for fusing the wire when the circuit upon the loop is broken.

MULTIPLE FUSE BLOCK. E. H. Montgomery, St. Paul, Minn., 571,093. Filed Aug. 10, 1895.
A switch adapted to be placed in each local circuit, so as to dispense with the necessity of other fuse blocks in the system.

AUTOMATIC CIRCUIT BREAKER. W. H. Powell, Hartford, Conn., 571,097. Filed June 15, 1896.
Details of construction.

LIGHTNING ARRESTER. A. J. Wurts, Pittsburg, Pa., 571,103. Filed March 11, 1896.
Comprises a non-conducting body and a pair of separated terminals provided with arc-suppressing means, and located in close proximity to one surface of the body, and means of repelling the air from the surface.

LIGHTNING ARRESTER. L. P. Culgan, Swissvale, Pa., 571,100. Filed June 1, 1896.
Comprises two tongues movable toward and from each other and provided with carbon buttons, the tongues being insulated from each other, and adapted to be connected to ground, and to a line wire, respectively.

ELECTRIC SWITCH. W. W. Hibbard, Rochester, N. Y., 571,119. Filed Nov. 21, 1893.
An arrangement by which signals sent over any number of separate main circuits may be transmitted to a side circuit without one interfering with another.

Telephones:—

TELEPHONE SWITCH. E. M. Harrison, Chicago, Ill., 571,162. Filed Nov. 21, 1894.
A telephone switch which may be operated by hand in connection with a suitable hook for supporting the receiving instrument.

MAGNETO TELEPHONE. E. M. and W. S. Harrison, Chicago, Ill., 571,190. Filed Nov. 21, 1894.
Comprises a diaphragm of permanent steel magnets, of unequal length, their like poles being separated at their lower ends by a diamagnetic heel-piece and electromagnetic coils on the pole pieces at the opposite ends.

OBITUARY.

FRANK P. ARBUCKLE.

Mr. F. P. Arbuckle, who was found dead under very suspicious circumstances, in a vacant lot at the uptown end of the Ninth avenue railroad, this city, on Nov. 19, was a well-known Westerner, and chairman of the Colorado Democratic States Committee. He was born in 1852; in 1870 he became connected with the telegraph service of the Kansas Pacific Railroad, building the line to Denver. He afterwards organized and carried on the Denver American District Telegraph Company, and one of his latest enterprises was the Denver-Highlands Electric Railway.

JAMES E. DEAN, the only son of Matthew Dean, president of the Municipal Electric Light Company, of Brooklyn, died on

November 1 in Guatemala, Central America. Mr. Dean was born in Brooklyn thirty-two years ago, and, after being graduated from Mount Pleasant Military Academy, went West. Four years ago he went to Guatemala. There he entered the electrical contracting business, and made money rapidly. It had been his intention to return home soon for a visit, but he was stricken with fever and succumbed in a few days. He was buried in Guatemala.

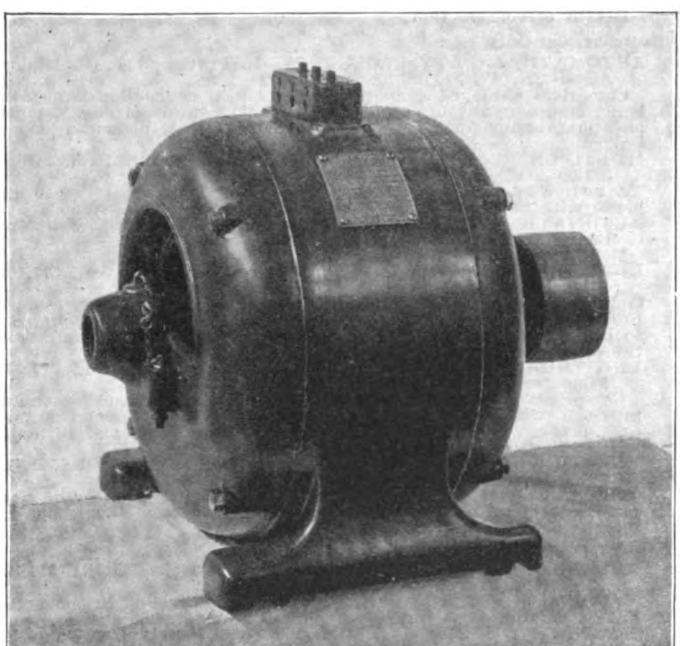
MR. WILLIAM G. ELLIS, president of the Amesbury National Bank, and a leader in the carriage building industry, died at Amesbury, Mass., on November 3, aged sixty-four. He was for several years the head of the Ellis Car Company.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW G. E. HIGH FREQUENCY SINGLE PHASE AND THREE-PHASE INDCUTION MOTORS.

THE new single-phase and three-phase high frequency induction motors of the General Electric Company have been designed to operate from circuits of 125 cycles, and to run at any frequency within 10 per cent. greater or less than 125 cycles with corresponding increase or decrease in the speed. The liability of the high frequency synchronous motor to be thrown out of step with any fluctuation in the speed of the generator is a disadvantage which does not seem likely to be overcome. If the feeder supplying current to a motor is changed over to another generator—a frequent occurrence in central stations—a fluctuation occurs in the frequency, the high frequency synchronous motor is thrown out of step and is brought to a stop. This can only be prevented by running the high frequency generators in parallel or by using high fre-



G. E. HIGH FREQUENCY INDUCTION MOTOR.

quency induction motors and consideration of this fact has brought the new line of motors into existence.

Two lines of motors have been designed—those for three-phase circuits and those for single phase. The mechanical structure and electrical features of the standard G. E. 60-cycle induction motors, also distinguish these. The armature or induced element in all sizes larger than 5 horse-power has a polar winding and a revolving starting resistance cut out by means of a lever. In the 5 horse-power size and less, the armature either has the polar winding and starting resistance or is built with individually short-circuited coils. While the latter is cheaper, the starting current required is greater and the starting torque less, the efficiency also falling below that of the motor with the variable resistance.

The field is wound with the conductors in slots, the winding being supported by end shields, which protect them from outside mechanical injury. The self-oiling and self-adjusting bearing are amply large; the oil cannot overflow and no oil can run out at the armature end. The connection board on the motor has no bare terminal connections and no part of the active conductors are exposed.

The full load rating is not the heating limit, but is determined by the safe margin allowed for the overload carrying capacity. The rise in temperature above the surrounding atmosphere when run continuously for 10 hours at the rated full load is not over 45 degrees Centigrade.

The speed, practically constant, does not vary with changes of voltage and cannot exceed the rated speed. If speed variation is required on the three-phase motors it can be obtained by the addition of collector rings and brushes and a rheostat in the armature circuit. No speed variation is readily obtainable in the single-phase induction motor.

The starting torque and starting current of the three-phase high frequency motors with resistance in armature are from 25 to 30 per cent. in excess of the torque and current at rated load. For special cases the motor can be built for a much greater starting torque.

The single-phase motor requires a starting box, starting it with half load torque and about one and a half full load current in the case of the motor with variable armature resistance. The box consists of a non-inductive resistance and a choking coil, the object being to establish a displaced phase of e. m. f. and produce a starting torque. When the motor is up to speed, the box is cut out, and the motor then runs as a simple single-phase motor. This motor can also be started with full load torque and a little over twice load current, but this necessitates a larger box. The single-phase motor with independently short circuited coils or fixed resistance in the armature requires about twice this amount of current when starting and gives somewhat less torque.

These induction motors are totally without moving contacts, and are standard for 104 volts. The smaller sizes can be run upside down or sidewise fastened against the wall, greatly economizing floor space. The high frequency three-phase motors have been designed to meet a demand for power service principally from high frequency monocyclic generators, and may be wound two phase for use on two-phase circuits of similar frequency. The single-phase motor meets the demand created for a motor to be operated on the existing high frequency circuits.

SOME INTERESTING EXPERIMENTS IN LUBRICATION.

At the sixth annual or 32d meeting of the American Society of Mechanical Engineers, held at the rooms of the society in New York City, in December, 1895, Mr. Albert Kingsbury, Durham, N. H., read a paper on "Experiments on the Friction of Screws." The tests were made by the aid of a specially designed machine built at the New Hampshire College shops. It now forms a part of the laboratory equipment of the college.

The author did not consider that the tests showed that any one of the metals developed less friction than any of the others, but the tests are specially interesting because of the great lessening of friction by means of graphite, as will be shown by the following:

Lubricator.	Minimum.	Maximum.	Mean.
Lard Oil	.09	.25	.11
Heavy Machinery, Oil, (Mineral)	.11	.19	.143
Heavy Machinery, Oil and Graphite (Equal Volumes)	.03	.15	.07

Mr. Kingsbury was complimented by Professor Thurston for the work he had accomplished. Personally Prof. Thurston had found that Sperm oil was better than Lard oil for reducing friction in such instances. He trusted that Mr. Kingsbury would continue his investigations.

Mr. Kingsbury felt gratified at the manner in which his paper had been discussed, and in reply to a question that had been asked, he said that the Graphite used was from the Joseph Dixon Crucible Company, Jersey City, N. J. He said he did not intend anything in the way of an advertisement. He also added that he had tried to purify the graphite, but there was no gain. In order to satisfactorily employ the graphite the fit must be loose.

Some years ago, when Prof. Thurston was connected with the Stevens Institute, he made a series of experiments to determine with scientific accuracy the value of Graphite as a lubricant. He found that under the same number of pounds pressure, and traveling at the same rate of speed, the bearings lubricated with Dixon's Graphite, mixed with enough water to distribute it over the bearings, did nearly three times more work than the best quality of winter sperm oil. He also found that when 15 per cent., by weight, of graphite was added to the best quality of lubricating grease, he was able to run the bearings nearly six times longer, at the same high rate of speed, than when the bearings were lubricated with the same

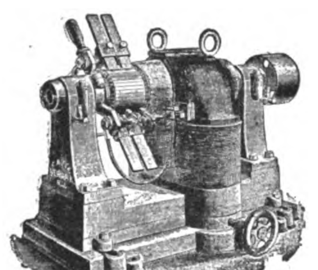
grease, without the addition of graphite. Furthermore, where the graphite was used there was no cutting and the bearings were in perfect condition.

Little, if any, of the commercial graphite in the market is fit for lubricating purposes, and bearings have been so frequently cut or ruined by its use, that there has been a very strong prejudice against its adoption by master mechanics and superintendents having charge of expensive machinery. It is safe to say, however, that when graphite is properly prepared, it will not only reduce friction much better than any oil or grease alone, but furthermore will perceptibly reduce the cost of lubrication.

THE ECK DYNAMOS AND MOTORS.

OUR illustration represents the type of new direct-current dynamos and motors now being brought out by Mr. C. A. Eck, 157-161 Oraton street, Newark, N. J., which combine the most essential features known to be best for the generation and use of electric currents. They embody the following valuable points: Perfect electrical proportioning, high efficiency, best insulation, simplicity of mechanical design, and best workmanship and materials. They are built with great care and no expense is spared either in materials or labor to make them as perfect as possible.

The field magnets are composed of wrought iron of the highest magnetic quality. The armature core is of the drum Pacinotti or iron clad type, proportioned with a view to maximum efficiency and slow speed; it is built up of well-insulated laminated iron, perfectly balanced to insure noiseless operation; the grooves are heavily lined with mica, the wire being completely embedded beneath the surface and covered with a plugging strip of mica, or fiber and securely bound by bands; consequently they will stand considerable rough usage. The commutator is of tempered copper, generous in size with many



THE ECK DIRECT CURRENT DYNAMO.

segments perfectly insulated under pressure with best mica and rigidly put together.

The bearings are all self-oiling and do not require attention oftener than once in two to four weeks. The bushing in which the shaft runs is of phosphor bronze and rests in universal or ball joints, to secure perfect alignment.

The brushes for the dynamos and motors of 110 volts and over are of coppered graphite or carbon; below 110 volts gauze or copper brushes are used. No, or very little current will pass through the spring of the brush holder and heat it because a better path is provided.

Each machine is thoroughly tested above its rated capacity before leaving the factory, and shipped in perfect order. If necessary, they will stand heavy overloads for short periods; change of load does not require shifting of brushes within its rated capacity, as the dynamos are all compound wound and are perfectly automatic in regulation.

SUNBEAM INCANDESCENT LAMP.

The following announcement has been issued by the Sunbeam Incandescent Lamp Co.:

We take pleasure in announcing that we have made arrangements to distribute the entire output of Sunbeam Lamps through the Western Electric Company, Chicago. In consequence of this arrangement, our Chicago office has been removed to the Western Electric Building.

All communications (excepting those relating to remittances) should be addressed to the Sunbeam Incandescent Lamp Co., 242 S. Jefferson St., Chicago. All lamps will be billed by the Western Electric Co., and remittances should be made to them.

We are also able to announce at this time that we have completed the equipment of our new factory at Desplaines, Ill. (just outside of Chicago limits) and we have not only very greatly increased our facilities, but have added in every department the most modern machinery and apparatus used in lamp manufacturing. We have also improved several processes of manufacture which will assist us in producing lamps more uniform and of a superior quality.

Those who are unacquainted with the Sunbeam Lamp as it is now made will find it to their advantage to place a trial order.

ANOTHER OF PENNOCK'S SCHEMES.

The subjoined unique circular will interest many people:

"THE PENNOCK ELECTRIC INVENTIONS.

"Electric Light. Electric Heat. Electric Power. Electric Ships. One hundred horse-power enters the Pennock voltage distributors, and one hundred thousand comes out. All produced at the cost of one hundred horse-power. All other inventors and magicians—Keeley, Tesla, Edison, Herrman, Kellar, et al.—knocked out. The Pennock inventions can duplicate with 200 horse-power the total horse-power that can be produced from Niagara Falls. A revolution indeed! 99,000 for 1. A fortune awaits your investment. Your money will grow in a night. We are selling the stock at $— per share. It may jump to higher figures at any time. The stock is full paid and unassessable. Address GEO. B. PENNOCK,
"193 Greenwich street, New York."

INPROVING TELEPHONE FACILITIES IN NEW YORK.

The New York Telephone Company has issued the following data, which contains several points of interest: The great improvement in the telephone service brought about by the complete reconstruction of the New York City plant on the metallic circuit basis, and the widening of the facilities by the extension of the system, and by large addition of subscribers, have led many of our subscribers to steadily increase their use of the service without providing additional facilities to cope with the increased traffic which their lines are called upon to carry. This leads to inconvenience, which is felt in many directions. The principal trouble is that an overburdened line is of necessity frequently reported "busy" to other subscribers calling for connection with it. This is a source of positive loss to the busy subscriber, as many calls intended for him are delayed, and some, no doubt, dropped altogether or directed elsewhere after one or two efforts to obtain connection have encountered a line almost constantly occupied with outgoing business.

The simplest form of relief for an overtaxed line is a double-track connection with the central office—two separate lines and stations, using one for outward and one for inward calls.

The charge for a second or auxiliary message rate station is $60 a year, all messages sent from it to be charged to the original station. If the original station is flat rate, the second line may be at the minimum message rate, viz., $90 a year for 600 local messages.

Where the telephonic requirements are on such a scale as to exceed the capacity of a double track arrangement with two stations, our sub-exchange system will be found admirably adapted to cope with the business, whatever its volume. This consists in placing telephone stations in different offices of an establishment as may be required. These telephones are all connected to a small switchboard from which trunk lines, in sufficient number to efficiently carry the traffic, run to the nearest central office. The system may be arranged for intercommunication between the sub-exchange stations if desired. Several large business firms in New York are now supplied with telephone service in this manner, and find the increased elacticity and capacity of the service a positive boon.

The rates for the sub-exchange system are: 4,000 messages, line and station complete, $225 a year; each additional station, $24 a year; each additional line to central office, $36 a year; additional messages, per 500, $15 a year.

THE BRUSH WORKS TO GO TO LYNN.

For some time past there have been persistent rumors with regard to the removal of the Brush Electric Company's plant to Lynn. Last week the reports were renewed. A special dispatch of Nov. 12 from Lynn, says: "Manager Walter C. Fish, of the Lynn works of the General Electric Company, says that it is true that the business of the Brush Electric Company, of Cleveland, O., is being moved to Lynn, and that hereafter the business of the Brush Company would be done in Lynn. The Brush Company is controlled by the General Electric Company, and manufacture arc-light dynamos and arc lamps. No additional buildings will have to be erected in Lynn, as the General Electric Company have plenty of factory space here in the buildings of the Thomson-Houston Electric Company.

INTERIOR CONDUIT IN THE WEST.

The trade will be interested to know that the Western Electric Company, of Chicago, has been given the agency for the products of the Interior Conduit and Insulation Company, of New York. All brass armored and iron armored conduits, elbows, couplings, fittings, etc., will be carried in stock in Chicago, and unusual facilities will be given to all jobbers and contractors for obtaining this material at the lowest prices.

The Interior Conduit Company has just brought out a special conduit which is much superior to anything which they have ever before placed upon the market. They have not only increased the excellence of this material, but have very materially decreased the price. The Western Electric Company is prepared to furnish new prices upon application. Coupled with this agency the Western Electric Company has also secured the agency for a fine line of standard, iron armored, slate-lined, panel, distributing, fuse, main and feeder terminals; also branch junction boxes. These boxes are specially designed and each box can be used on either two or three-wire system. Those interested should write for catalogues and special quotations.

CLAYTON AIR COMPRESSORS IN DEMAND.

A contract for twenty-five air compressors and twenty-five air receivers, of medium and small sizes, has been closed by the Clayton Air Compressor Works, Havemeyer Building, New York, with one company, delivery of the entire order to be made within six months. They also report sales of five air compressors of standard pattern during the first week in November, and the indications point to a decided revival of trade in air compressors, many orders having been held in abeyance pending the result of the election.

CONDUITS AND CABLES.

Mr. John T. McRoy, of Chicago, has brought out a little catalogue of his terra cotta conduit. The fact that the little booklet is terra cotta color adds to the suggestiveness of it. The catalogue deals with the character of the material used in the manufacture of the conduit and its practicability, and contains a little argument running through the pages as to the special value of the McRoy production, closing with some testimonial letters and an illustration of the strength of the conduit.

ADVERTISERS' HINTS.

THE ELECTRIC APPLIANCE COMPANY publish a letter testifying to the excellence of the Boudreaux dynamo brush.

C. A. ECK, 157 Oraton street, Newark, N. J., builds high grade dynamos and motors ranging from 1/8 to 10 horse-power in size.

THE F. J. PEARSON MANUFACTURING COMPANY, of St. Louis, are manufacturing a Crookes tube which they claim is superior to those of foreign make. The price is $5 net, delivered.

THE GLOBE ELECTRIC HEATING COMPANY, Philadelphia, Pa., illustrate in their "ad.," this issue, a portable heater designed for residences and offices. It consumes 6.8 amperes on 110-volt circuit, or 1.5 amperes on 500-volt circuit.

WILLIAM TOD & CO., Youngstown, Ohio, are building the Williams improved vertical engines. They are equipped with valves and gear capable of any rotative speed at which the shafts and reciprocating parts may be operated with safety, thus securing any speed desired.

MR. WM. TAYLOR, 203 Broadway, New York, is offering Edison incandescent lamps at 12 cents. There are about 7,000 of them, 16 candle power, ranging from 100 to 105 volts; are new and are sold at this figure as the voltage is too low for the circuits they were intended for.

WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., report their engine sales for October to have averaged 150 horse-power daily. This is all the more remarkable owing to the inclination of buyers to postpone purchasing until after the election, and the above company should be congratulated on having an engine that is considered a safe investment at all times.

J. B. COLT & CO., 115 Nassau street, New York, call attention to the Criterion magic lanterns used in giving the election returns in Printing House Square on the night of November 3. Each lantern was provided with one of their automatic arc focusing lamps, capable of the finest adjustment, as are all lanterns sold by this company, who manufacture them for stage and balcony uses, as well as for scientific work in colleges, laboratories, etc.

NEW YORK NOTES.

THE ELECTRIC RAILWAY COMPANY of the United States, owning the Field and Edison electric railway patents, at the meeting of its directors last week, decided to apply for a receiver to wind up the affairs of the company.

BROOKLYN NAVAL HOSPITAL. The firm of J. A. Walker & Company, Philadelphia, is carrying out work on two or three new buildings at the hospital. Electricity is to do the lighting, and two electric elevators will be furnished, each to be large enough to carry a patient on a cot with an attendant.

BAECHTOLD & PARKER ELECTRIC COMPANY, 79 Washington street, Brooklyn, have had to enlarge their floor space owing to an increased business. They are running with a full complement of men. Aside from electric repair work, they are offering a large and varied line of second-hand arc dynamos and lamps; also a line of incandescent dynamos.

RANDOLPH & SULLINGER, 114 Nassau st., New York, electrical engineers and contractors, designed and installed the electrical display, election night, at the Union League Club, consisting of red, white and blue streamers, legend of McKinley and Hobart, and seven large searchlights of their own design. Among the many buildings installed by this firm can be mentioned the Hotel Renaissance (all the wiring), show windows at Cammeyer's Shoe Store, motors and all the wiring in O'Neill's dry goods establishment.

THE ELECTRIC ENGINEERING AND SUPPLY COMPANY, of Syracuse, N. Y., have almost ready for distribution a very complete catalogue of about 125 pages, containing illustrations and price lists of all the articles of their manufacture, consisting of railway material, line material, hoods; a complete line of incandescent supplies, and a very extensive display and price lists of jack-knife switches. There will be over 25 pages of tabulated lists on their jack-knife switches. A special feature of this catalogue will be illustrations and prices of all switch parts and switchboard parts, all of which are illustrated and listed. The catalogue is No. 7.

MR. WM. S. TURNER has opened an office in the Postal-Telegraph Building, 253 Broadway, New York, where he will carry on a consulting and constructing engineering business in electric railways, lighting, power transmission and steam engineering, similar to that heretofore conducted by Woodbridge & Turner Engineering Company, which concern has recently discontinued business.

An active and continuous experience of ten years in designing, constructing, supervising and consulting in the abovementioned departments of engineering work enables Mr. Turner to merit confidence and good will and he proposes to maintain the highest standard of skill and workmanship in all departments of work entrusted to him.

WESTERN NOTES.

MR. F. B. DOWNING, assistant manager of the Keystone Electric Company, Erie, Pa., was a recent visitor to Chicago and the West in the interests of his company, and he feels very confident that they will have a considerable addition to their business in the near future.

MR. ALEX. CHURCHWARD, electrical engineer of the Excelsior Electric Company, made a recent trip to the West, and when in Chicago called in at the office of the Engineer. Mr. Churchward is most energetic, and it is reported that he is on the qui vive as to the expected installation of a large transmission plant in the West.

MR. C. E. WOODS, who is well known in the electrical trade, from the fact of his having been connected with the National Electric Company, Eau Claire, Wis., and the Standard Electric Company, Chicago, as a designer of dynamo electric machinery, and later by his work in inventing and developing the electric vehicles manufactured by the American Electric Vehicle Company, Chicago, has severed his connection with the latter company, and is now permanently connected with the Northern Electrical Manufacturing Company, Madison, Wis. Mr. Woods' duties in his new position will consist in designing motors and generators to be manufactured by this enterprising young concern, who are now more than ever in a position to push for business.

NEW ENGLAND NOTES.

THE AMERICAN ELECTRIC HEATING CORPORATION, Sears Building, Boston, has just issued to its friends a copy of King's Views of the Hub, a very pretty and interesting collection of halftones from photographs which give an excellent idea of modern Boston.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. DECEMBER 2, 1896. No. 448.

ELECTRIC LIGHTING.

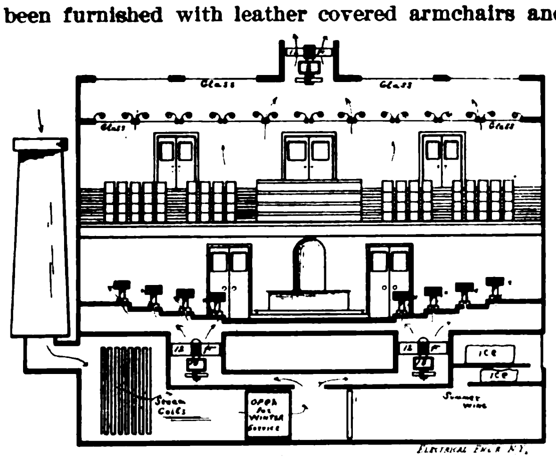
THE NEW ELECTRIC LIGHTING AND VENTILATING PLANTS AT THE U. S. CAPITOL.

BY NEVIL MONROE HOPKINS.

WHEN the Fifty-fifth Congress convenes on December 7, it will mark the inauguration of the extensive electric lighting and ventilating plants that have been installed during the past summer. The House of Representatives, Senate and Capitol grounds are to be brilliantly illuminated by the electric

THE U. S. SENATE CHAMBER.

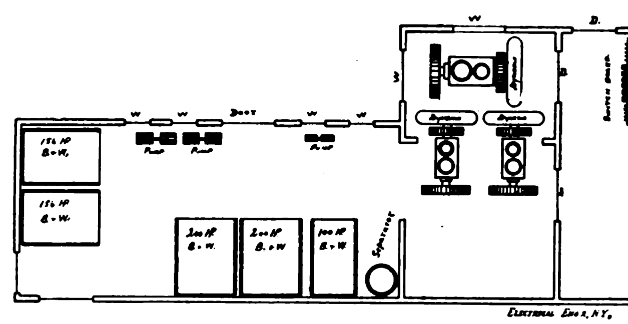
light, displacing the antiquated gas fixtures that have served during so many important proceedings. Not only has the Senate been furnished with the electric light, but the galleries have been furnished with leather covered armchairs and the



PLAN OF U. S. SENATE ELECTRIC LIGHTING PLANT, NATIONAL CAPITOL.

historic chamber equipped with the most modern and approved system of ventilation. Both the House and Senate are lighted from the skylight the same as before the change in lighting systems, the gas burners being left in place to serve for melting the snow away from the glass roof which often darkens the floor below.

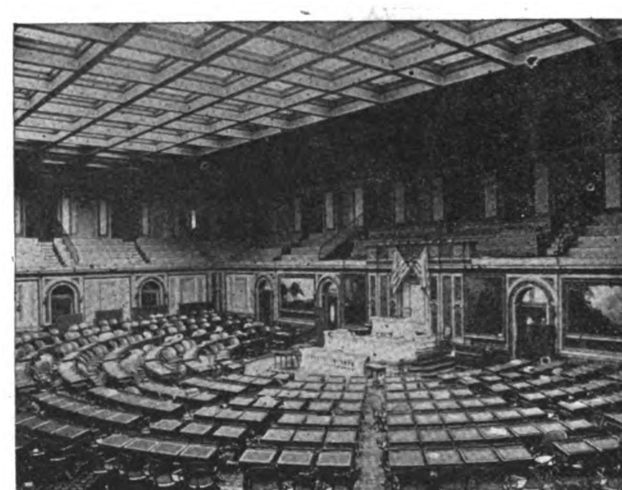
A general idea of the ventilating system can be formed from the illustrations, which illustrate the modern principle. The fans under the flooring are 12 feet in diameter and are driven by electric motors of 18 h. p. each. The fan on the roof is also 12 feet in diameter, but is connected to an 8 h. p. motor. The pure air is drawn from a stone tower situated on the northwest section of the Capitol grounds, and between



PLAN OF LIGHTING AND VENTILATING SYSTEM, U. S. SENATE, WASHINGTON.

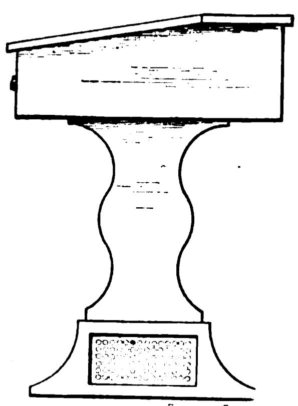
steam piping before it is driven up through the double, airtight flooring, and out in to the Senate through the perforations in the feet of the numerous desks. Each desk is provided with means of shutting off the supply of air or regulating it. An ice plant is to be installed later and means for cooling the air will be provided for sessions in warm weather.

The wiring throughout is on the two-wire system, incandescent as well as arc light being run on the same circuits. Arc lamps of the Manhattan incandescent type illuminate the grounds and are 150 in number. Owing to the numerous trees on the Capitol grounds it was quite a problem to place the lamps advantageously, but Mr. C. P. Gliem, electrician for the Capitol, has carefully plotted out the grounds and distributed his lights in an excellent manner. Mr. Gliem has also directed the wiring of the building and distribution of feeders, etc. In addition to the 900 incandescent lights that illuminate the Senate and the 1,100 in the House, many hundred are wired through the corridors and reception rooms.



THE U. S. HOUSE OF REPRESENTATIVES.

Descending to the basement one finds two entirely separate electric plants, almost identical in design and appearance, consisting of the same make of machinery and boilers. Our illustration shows a plan of the engines, dynamos and boilers on the Senate side. The boilers are all of the Babcock & Wilcox manufacture, furnishing steam at 100 pounds initial pressure, and aggregating over 800 horse-power. The two boilers on the extreme left of the diagram are used for heating the Senate and the corridors on the Senate side, while the House is equipped with a similar battery for warming the air in the other half of the building. The engines are of Westinghouse manufacture of the compound type and are run on condensers. The two placed side by side are of the same capacity, having cylinders 14" x 24" x 14", and run at 300 revolutions per minute, directly connected to generators of Westinghouse make, with six poles, 75 k. w. capacity, and wound for 110 volts pressure. The third engine and generator shown at the back, furnishes 187 k. w. also at 110 volts, revolving at the rate of 250 turns per minute, the generator having eight poles and the engine cylinders measuring 18" x 30" x 16". The switchboard is not yet permanently in position, but will measure about 8 x 12 feet, of white marble, 2¼ inches thick, equipped with Westinghouse indicating instruments. Our photograph of the Senate was taken before the alterations were commenced, and a visitor familiar with the old chamber, on entering during the day, would probably make no comments beyond speaking of the armchairs in the gallery that have taken the place of the former wooden benches. The cost of these alterations is $55,000, for which an appropriation was made at the last session of Congress. Should the heating and



End View, Ventilating Desk, U. S. Senate.

ventilation prove to be all that is expected, a duplicate installation will in all probability be voted for installation in the House of Representatives.

THE GENEVA ELECTRICAL WORKS.[1]

BY J. E. PETAVEL.

THE use of water as a motive power dates further back in Geneva than in most other towns. This is accounted for by its position at the overflow of a natural millpond of some 223 square miles in area. As early as 1708 the town was provided with a complete hydraulic station, while various mills and factories already occupied the banks of the river. In 1886 all the previously existing water-wheels were finally swept away, and one large central station erected, capable of utilizing the whole power of the Rhone at its outflow from the lake. Part of the 3,780 horse-power thus available was utilized for the water supply of the town, the main portion, however, being distributed as motive power by a network of high-pressure water mains. In a very few years the demand for power had risen to nearly the full capacity of the station, and to meet future requirements the municipality decided to erect a new station at Chèvres, some four miles further down the river, the estimated cost being $1,200,000. It was with the construction and working of this station that we now propose to deal.

The current of the Rhone beyond Geneva is rendered extremely variable by the influx of the waters of the Arve. In summer, when the mountain snows are melting, the flow may attain to 32,000 cubic feet per second; but to prevent inundations the head of water is not allowed to rise above 14 feet 9 inches. In winter, on the contrary, the flow of the river is reduced to 4,200 cubic feet, and the whole of the water passes through the turbines under a head of 27 feet 11 inches.

[1] London "Electrician."

To satisfy these widely varying conditions, a special design of turbine had to be adopted.

The weir consists of seven massive concrete piles, 9 feet 10 inches in width and 56 feet in length, rising to 31 feet above the sill. Supported on a series of pillars at a height

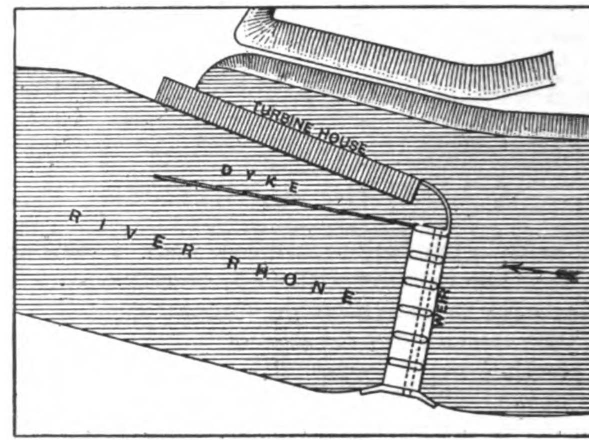


Fig. 1.—Chevres Station, Geneva Electrical Works.

of 16 feet above the top of the piles, is a bridge, on which is placed the necessary machinery for raising and lowering the seven sluices. These are 28 feet high and 33 feet wide. They move on a series of rollers, and are balanced with an iron counterweight of 50 tons. Thanks to this mechanism, two men can easily work them, even when the pressure on their surface rises to 360 tons. M. Turrettini, the chief engineer of the Chèvres works, adopted for these sluices the design he had seen in use on the Manchester Ship Canal. The dyke shown in Fig. 1 prevents the rush of water from the weir from raising the level of the water in the tailrace of the turbines. The power house when completed will contain 15 sets of turbines, each set being capable of giving from 800 to 1,200 horse-power, according to the level of the water; thus the total power of the station will not be less than 12,000 horse-power.

The difficulty we have already pointed out with regard to the design of the turbines was overcome in the following manner: Two complete turbines were placed one above the other on the same shaft, the lower one alone being used in winter, when the available quantity of water is small. This turbine can give up to 1,200 horse-power, under a head of 28 feet, the full load efficiency being 75 per cent. Under a head of 14 feet 9 inches this same turbine only gives 400 horse-power, and it is then that the upper one is brought into use to make up a total of 800 horse-power. To allow for

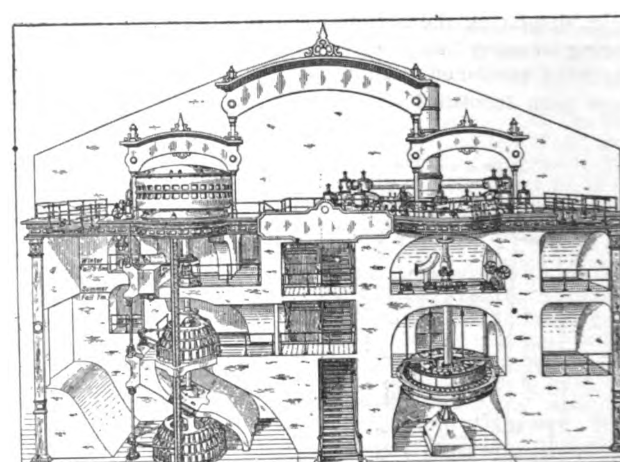


Fig. 2.—View of Full-Size Model of Geneva New Electrical Works.

the passage of a sufficient quantity of water without increasing the external diameter, and therefore decreasing the angular speed, the vanes and guides are disposed in three stories on three concentric circles, thus giving to each turbine the appearance of a large cone. The view shown in Fig. 2 will give a clearer idea of the turbines and alternator employed than any lengthy description we could give. It is taken from a full-sized model placed in the Geneva Exhibition. On

the left-hand side we see the plant used at Chèvres, and on the right a turbine of the pumping station of the town to which we refer at the beginning of this article. Since the close of the exhibition these turbines are being fitted up at their respective stations.

The Chèvres turbines are provided with a regulator so arranged that a very small angular motion will entirely cut off the water, and thus rapidity of action is secured. An ordinary centrifugal governor actuates a small slide-valve, which admits oil under a pressure of 15 atmospheres to one side or the other of a piston, this piston in turn governing the regulator.

The top of the main shaft supports a large cast-iron bell, 14 feet 9 inches in diameter, which, as we shall see later, takes the place of the field-magnet of the alternator. The total weight of the movable part is about 30 tons, rising with the pressure of the water on the vanes to 40 or 50 tons under full load. The method adopted to prevent excessive friction is worthy of note. The main shaft carries a large disc, ground perfectly true on its lower surface. This disc bears on another, which forms part of the bed-plate of the alternator. Before starting the turbines, oil, under a pressure of about 15 atmospheres, is forced between these two discs, thus lifting the shaft a few thousandths of an inch, and floating the whole revolving mass on a surface of oil. Under these circumstances the friction is so much reduced that one man can set the alternator in motion. Three sets of pumps, driven by electric motors placed on the exciter-circuit, force the oil into

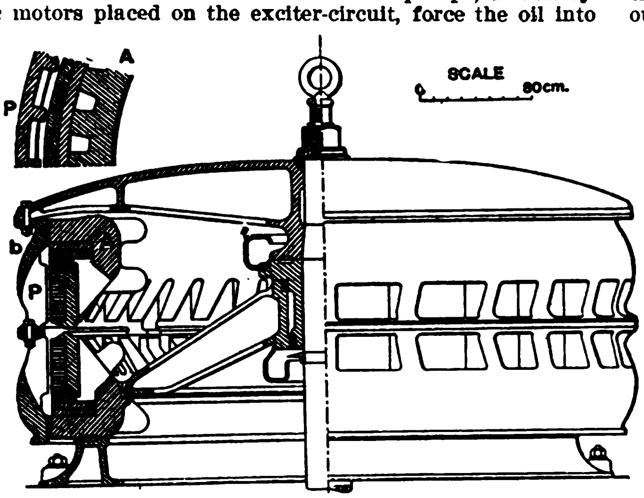


FIG. 3.—ALTERNATOR, GENEVA ELECTRICAL WORKS.

an accumulator, where a pressure varying from 12 to 25 atmospheres is maintained. This accumulator can supply the necessary flow of oil for a few minutes should a breakdown of the pumps occur. These pumps will in time be replaced by a set forcing a constant flow of oil through each turbine, the pressure adapting itself automatically to the weight of the moving parts.

The principal point of interest lies in the fact that both field-magnet coils and the armature windings are stationary. The alternator is double, each half forming a complete machine and giving one phase. It is so constructed that by changing the relative positions in which the upper and lower halves of the bell-shaped inductor are bolted together, the two phases can be brought into synchronism.

Referring to Fig. 3, we will limit ourselves to describing the upper half of the alternator. The fixed part of the magnetic circuit is formed by an iron ring, A, in which a space has been reserved for the field-magnet coils.

We may note in passing the way in which these coils were wound. A circular rail was laid round the alternator already erected in position. On this line, a truck worked by a small electric motor ran round and round, winding the coil as it went.

The lower face of the ring A is made of laminated iron, and on this are placed the armature coils. Opposite this face, and forming part of the bell, are a number of polar projections, P. These poles, as they revolve, carry round the magnetic field, thus producing the desired electromotive force. The magnetic circuit is completed by the side, b, of the bell and the upper part of the ring.

The tests of the first alternators, though quite satisfactory in other respects, showed the electromotive force to be very much lower than the calculations had led to expect. This was attributed to the presence of a small percentage of manganese in the composition of the iron.

The transmission line is about four miles in length, and entirely underground. The conductors are laid in a concrete conduit 15¾ inches wide by 11¾ inches deep, the flooring being 2 feet 4 inches below the surface of the soil. Walls and floor are first coated with an insulating preparation of tar, then bare copper conductors are stretched over porcelain insulators placed at intervals of 2 feet along the line, and the conduit is filled up with asphalt concrete, poured in at a temperature of 200° C. In the upper part of the conduit, seen in Fig. 4, are three small cables containing the telephone and pilot wires. The whole of this work is protected by a concrete cover. The pressure on the line is 3,000 volts, and for the first few months the insulation did not prove as satisfactory as had been hoped. Of late, however, the condition of the line has greatly improved. To ascertain the position of any fault, two men walk along above the conduit, each holding an iron staff, connected by a wire some 20 or 30 yards long. In this circuit is inserted a telephone, which immediately signals the existence of a fault. Four lines were necessary; each one consists of seven cables, and each cable of seven wires 3.6mm. in diameter. The cross section of one of the lines is, therefore, 0.76 square inches.

The centre of the town of Geneva has already, for several years past, been supplied with continuous current on the three-wire system; the pressure adopted is 2x110 volts. The older dynamos are now being replaced by a set of rotary transformers utilizing the power received from Chèvres. The outskirts of the town are provided with alternating current

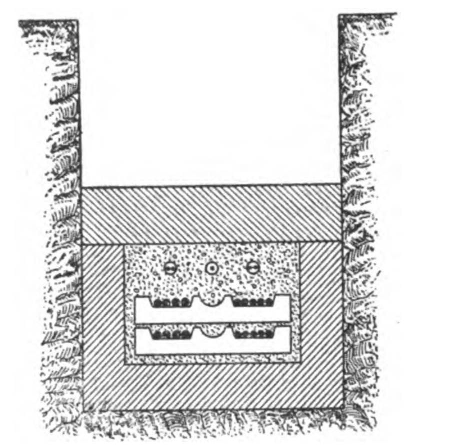


FIG. 4.—ELECTRIC CONDUIT, GENEVA.

by a number of small transformer stations. Three wires are used, the motors and lamps being so distributed as to keep the load on the two phases as equal as possible.

It is on the low-pressure alternating-current network that the 150 arc lamps, which light the principal streets of the town, are placed. A separate transformer is used for each lamp.

A number of tramway lines radiate in all directions round Geneva. Eight or ten of these have been constructed within the last few years, and several are already being worked on the overhead trolley system. The experiment having proved thoroughly satisfactory, the other lines will in all probability shortly follow suit. The municipality furnishes power to the tramway company at the exceptionally low rate of 2.30 c. per kilowatt-hour.

The electrical works we have just described were carried out by the Compagnie de l'Industrie Electrique of Geneva, and our thanks are due to MM. R. Thury and A. Graizier for the valuable information they have kindly furnished.

SPRINGFIELD, MASS.—Trouble has arisen over the frequent outages of street lights, and the street light committee has been holding up the bills. Mr. H. S. Anderson, manager of the Electric Light Company, claims that the average time each light has been out during a month is only three-tenths of 1 per cent., which is lower than the general New England average of four to six-tenths, excepting Worcester, where it runs about a quarter of 1 per cent. He said that "if lamps could be had which would not go out so easily, it would well pay the company to put them in, as then they would save part of the cost of inspection."

MR. WILLIS A. ROTH, of Buffalo, has been appointed electrician of the Long Island State Hospital, at Brooklyn, from the civil service eligible list, at a salary of $900 a year.

STUDIES IN THE SPECTRUM OF REFLECTION.—II.

BY DR. W. H. BICHMORE.

BUT after all what is the purpose of all this study, what justification is there for this labor, in a word, what is its practical bearing? Just this, we are dealing scientifically and commercially with a method of illumination in which a large sum of money is invested. This method has no natural monopoly of the business; far from it, to-day it stands head and shoulders above its competitors. But how will it stand this day week? They are hardly rivals, and yet at times they run it closely. The Welsbach mantle offers a volume of light simply enormous, and when the objections to it are either unknown or ignored, has a foothold and a following which promises to be permanent if not to increase. There are other projects for using the power of electricity, as a means of obtaining light; some have had a quasi exploitation, some are only laboratory experiments, but any day may see attacks made from unexpected positions by unsuspected foes, and it is the duty of every one who is directly or indirectly interested in defending our industry to know all we can that we may the better do our duty in the hour of need.

Clearly therefore, leaving the task of bettering the lamps to those whom it may concern, we must use every effort to get all we can from the lamps as they stand, and use every justifiable means of making others use the lamps to the best advantage.

It seems almost gratuitous to say that the pressure must be held up or the lamps will not give the light they should, for they will not get hot, yet there are dozens of buildings in New York City where, if the current is measured as it comes from the lamps, it will be found to be underrun. Nothing is more simple than to try it, and nothing is more convincing than the result. When anyone complains, the usual procedure is to remove the lamp and screw in a new one, and the public has gathered the impression that the lamps are at fault when they are nothing of the kind. But there is equally no possible sense in over-supply; this also is done. There is one building in Broadway in which the lamps "burn blue," and neuralgia is the order of the day.

When the stenographer and type-written matter is in evidence this is the worst fault of the twain, for the paper and ink approach too closely in their reflection spectra under such conditions for any good to follow increased illumination. But it is by simply teaching the public how best they can use what they have that the greatest progress can be made.

It is quite curious to note the differences in detail of samples of paper, of ink, of ten thousand things in this regard, all of which have bearing not to be neglected. In that theory of color for which Fraunhofer and Brewster are responsible, the legitimacy of the use of the color for what we call black and white is vigorously denied. Yet there is no rational doubt that this theory of color hinders the best use of lamps by many who are unconscious of its influence, and certainly could not state it correctly if they were to try. To most people the statement that white is the presence of all color and black is the absence is true, because it is orthodox, but such a black and white no human being would know as such if he saw it, nor would he ever see it, for equally neither could bring sense image to him; each alike would be a contrastless whole, an indistinguishable void.

"The whitest whites,, known to the arts are iron free kaolin and barium sulphate, yet spectroscopically they are both of them greens, and the black of lamp black is a shade of red while that of plumbago is a blue. It is this misconception which baffles so many efforts, colors must be studied under different auspices, and with a different purpose in view than the usual one; rooms must be finished not simply to please the eye by day, but to gratify the sense of rest by night.

The real question is how shall we meet the blue of our lamps? Every school boy who has studied Ganot's "Physics" knows that if two sun spectra be crossed at right angles, the blue and yellow mutually neutralized show white, and that against a bright ground of this color a small square of spectral red and green superposed shows black.

Reducing the facts to their exact bearing, it may be said that the sum of the waves from 6,460 to 5,945 added to those between 4,895 and 4,600 present, when exposed against those between 5,945 and 4,895 added to those between 4,600 and 4,307, the strongest possible contrast. Here lies a remedy for much of our complaint: the adoption of a yellow-blue combination as white which will give a maximum reflection and consequently a maximum illumination when subjected to the blue-green combination with the yellow which is the brightest light of incandescent carbon.

Familiar examples of this thing are the Winsor and Newton and Reynolds patent bristol boards. Winsor and Newton is rather too blue, Reynolds too yellow for criteria, but by the incandescent filament one is a deep dead white into which one may almost see, the other a brilliant superficial one which seems almost to shine. Again and again have I measured the spectra of reflection, again and again have I in wonder asked myself why so small a difference parts them so sensibly.

The most perfect white among papers which I have studied is that of a drawing paper by Harding. So little superficial reflection was there that after stretching, the absorption bands in colors put upon it were plainly to be distinguished, yet it reflected light with an equality of action to which that of barium sulphate is alone to be preferred.

In white pigments I find that among surfaces rubbed down with pumice stone, white zinc gives an unexpectedly high result, better indeed than unmixed white (carbonate) of lead; sulphate of lead stands very high, but neither equals barium sulphate. This was specially interesting, because some time since I chanced to examine very carefully a sample of lead paint, "pure white lead," as usual, carefully adulterated with barium sulphate by the Erni process, which had the highest uniform index of any paint I have ever seen. It is beside the subject in a way, but excepting compressed barium sulphate made in tablets for the purpose, I have no knowledge of any white surface approaching so near a theoretical white as this. Ordinary hard finish is not in the list with it. If the barium adulterated paint were only openly sold as such and were put on and surfaced as this specimen was, it would be the most perfect white for interior work known to me.

Barium sulphate mixed with just enough plaster of paris to hold it wet and allowed to set, also makes a magnificent reflection surface for all very hot carbon lights, but it will not stand, at least my endeavors to make it do so have failed.

Taken in their order of performance values, illuminated by incandescent filament lamps running under full voltage, these pigments run: Barium sulphate, iron free kaolin, sulphate of lead containing barium sulphate, oxide of zinc (Chinese white), common white lead prepared by the "new process" which is a sulphate, and common white lead prepared by the "old process," which is a carbonate. Next to these, but also showing white to the unaided eye when illuminated by the incandescent filament, come two series of colors belonging to quite different groups, one having an excess of yellow reflection by sunlight, the other an excess of blue.

Of these yellows the first is ordinary zinc white, this is deficient in general reflection capacity, but reflects excess of yellow as stated. With it ranks a sulphide of cadmium, a most extra brilliant pigment considered in this connection and the third I have purchased as "lead yellow," but have not troubled myself about it further. These three pigments present the peculiar relations of an underrun and overrun circuit crucially; indeed the color which cadmium sulphide takes is a very crux for the lamps. When the lamps are getting their full allowance of the current, the sulphide of cadmium shows white, an ivory hue beautiful and dazzling in its brilliancy; but let the voltage fall never so little and a wretched guy takes its place, closely resembling that produced by washing a piece of Whatman Not with an exceedingly thin wash of neutral tint and following that with an equally attenuated wash of gamboge. The water-colorist can tell many a tale of disappointment due solely to these irregularities of the current, and more than one sworn foe of the filament lamp, and equally sworn friend of the "mantle" dates his change of heart to an experience of the sort suggested.

The blue-greens, "peacock tints," and the true yellow green of the spectrum obtained by imitative color-pigment present changes quite as striking but in inverse order. These also are modified by the changes in hue of the emission, but the whitening from the underrun circuit is less interesting than the change called up by the excess of the blue reflection. It will be noticed that among the illumination curves plotted there are a pair in which the illumination by electric light exceeds the illumination by daylight. As was mentioned in the previous chapter, this paper is a blue-green one, and it requires for its best illumination just the colored light the fully .heated incandescent filament emits. Working along these lines to enlarge the list I found that the group which gives this illumination most nearly are green-blues made with cobalt and raw sienna. Why this group illuminates better than Prussian blue and raw sienna I do not know, but that they do illuminate I do know. If the use of blues and greens of this tint can be widely encouraged, it will add to the needs of all a new relief, but there are drawbacks. This reflected blue-green guys all colors not itself and, like time, changes all things to a monotone, and an unpleasing one. The resulting effect to all bright lines not peacock tints is a saddening one. I can give no list of pigments as I gave under whites,

for these tints are all mixed ones, but I can mention one or two curious facts. The pigment known as viridian, i. e., the chromium oxide, is particularly ruined by this overrun illumination, while the deficiently warmed lamp is much less injurious to its hue.

I do not by any means consider this subject as exhausted, but I think enough has been written to show the importance of knowing in advance how hot the lamps will be, and considering what effect the light they give will have on the color of things in the room.

NEW YORK STATE CONTROL.

Assemblyman H. E. Abell, of Brooklyn, is to introduce a bill in the next Legislature placing all the gas, electric light, telegraph and telephone companies under the supervision of a State Commission, after the manner of the Commissions on banks, insurance and railways.

MUNICIPAL LIGHTING DISCONTENT AT JACKSONVILLE, FLA.

There has been considerable complaint for several nights about the city electric lights being out, and there is talk of enjoining the city from running on a so-called moonlight schedule.

LAMP-TRIMMING AT FLATBUSH, N. Y.

The lamp trimmers of the Flatbush Electric Light Company, Long Island, complain of having too many lamps to trim since the city lighting was increased in that suburb. The men claim that they have as many as ninety lamps apiece to look after daily, scattered over ten miles of street. They get $12 a week. Supt. Conklin does not consider them hard-worked.

NEW LIGHTING CONTRACT FOR JERSEY CITY, N. J.

The Street and Water Commissioners of Jersey City have made a five-year contract with the Jersey City Electric Light Company for the lighting of the city by electricity. The contract is considered an unusually favorable one by the officials. Under the contract just made one thousand electric lamps will be furnished during the ensuing fiscal year and from then until the expiration of the contract not less than nine hundred are to be furnished, all over that number being governed entirely by the appropriation made for street-lighting purposes. The precaution was taken not to fix one thousand lamps for the whole term in order to meet with any possible sweeping reduction in the appropriation which is now $123,800 a year. When bids for the lighting of the city were called for the Street and Water Commissioners reserved the right to make a one, three or five-year contract with the lowest bidder. It was found that under the prices submitted for the one and three-year contracts, provision being made for three hundred gas lamps and seven hundred oil lamps, that the appropriation would be overdrawn if nine hundred electric lights were to be furnished. Under the five-year prices, however, that difficulty was overcome. On the basis of nine hundred lights the Jersey City Electric Light Company agreed to furnish each light at $99 a year. Allowing that one thousand lamps are used during the term of contract the annual cost will be $99,000. The gas and oil lamps, reglazing and furnishing of necessary supplies will cost about $23,300, which will still leave a margin in the appropriation of $123,800 of $800 for emergencies. It is shown by the commissioners that in contracting for five years instead of one year the city saves $9,900, and $6,300 is saved by making the long term contract instead of three years.

A STUDENT TAMPERS WITH A LIGHTING PLANT.

There have been troubles of late in the Warwick Electric Company at Wellington, O., which operates a plant. A college student when arrested made a confession that he and others had destroyed machines belonging to the system for lighting the city and had stolen workmen's tools. It is said he was induced to do this by disgruntled stockholders, who wished to impede the receiver of the plant in the discharge of his duties.

MORRISTOWN, N. J.—The Morris County Electric Company is increasing its plant by the addition of a 650 horsepower Ball & Wood cross-compound engine fitted to run three 2,000 light generators. One new General Electric generator of 2,000 incandescent lights capacity, and possibly two, will be put in at once. Work has already been commenced and the plant will be in operation within a few weeks. A store house is also being erected on the lot on the easterly side of the railroad recently purchased by the company.

MISCELLANEOUS.

MAGNETIC SURVEY OF MARYLAND.

THE Maryland Geological Survey, in an endeavor to make its work fundamental and at the same time of the greatest value to the material interests of the State, has taken up, in its preliminary investigations, a thorough study of the magnetic conditions affecting that portion of the earth's crust within the borders of Maryland. In addition to the far-reaching importance of this work upon the future observations and determinations of the great rock masses contained within our State, these investigations will be of immediate practical benefit to all land surveyors, and from that standpoint alone will more than justify the undertaking.

The investigations are being conducted under the direction of the State Geologist by Dr. L. A. Bauer, who is in charge of the department of terrestrial magnetism in the University of Chicago and was for some years prior thereto connected with the Coast and Geodetic Survey in Washington. By the courtesy of the Secretary of the Treasury the costly apparatus in the possession of the Coast and Geodetic Survey has been placed at the disposal of the Geological Survey of Maryland during the summer and autumn months of the present year, an arrangement which has alone made the work possible. At the same time the American Association for the Advancement of Science has allotted to Dr. Bauer a sum of money to aid in carrying on the investigations. It will thus be seen that much support has been secured from outside.

A magnetic survey involves the determination at a number of points of the so-called magnetic elements, viz., the magnetic declination, the magnetic inclination or dip, and the horizontal component of the earth's magnetic force. These three elements completely determine the direction and intensity of the magnetic force prevailing at those points.

Magnetic declination, or, as the mariners and surveyors frequently term it, variation of the compass, involves, first, the determination of the true north and south line, which is obtained by astronomical means alone, and, second, the determination of the magnetic north and south line, which is the direction taken by the compass needle. The magnetic declination is the angle between these two lines, and is recorded as so many degrees east or west of north. In Maryland this angle varies from about 6 deg. west in the northeastern corner of the State to about 2 deg. west in the northwestern part. This is the element which chiefly concerns the land surveyor, but which he is rarely, if ever, able to independently determine.

Magnetic inclination is the angle of dip, which, in our hemisphere, the needle makes below the horizontal plane, the needle being placed upon a horizontal axis and moving in a vertical plane through the magnetic north and south line.

The horizontal component of the earth's magnetic force is further determined by a specially constructed magnetic needle, the time of vibration being obtained under the influence of the earth's magnetic force in combination with the angle of deflection which this magnet produces on another magnet at a given distance. This gives the absolute value of the horizontal component, while relative values may be obtained at the same time by referring the observations taken to a central base station.

The importance of magnetic surveys has been recognized for many years, the first survey of this kind having been made in England in 1837 and the third survey having but just been completed in that country. Surveys have also been made in several of the other European countries, although little systematic investigation in this direction has as yet been undertaken in America. Some preliminary work has already been done in Missouri, Pennsylvania and Iowa, while the United States Coast and Geodetic Survey has made observations at widely separated points. Nowhere in this country has such systematic and complete observations been taken as in the magnetic survey of Maryland. About forty stations in all have been established, or one for about every 250 square miles, which entitles Maryland to the claim for making by far the most detailed magnetic survey yet undertaken in America. The proximity of the Magnetic Observatory in Washington will largely add to the value of the work, as the observations made in Maryland can be readily compared with the continuous records of this observatory. By means of the observations thus far made preliminary iso-magnetic maps for the State can be constructed in the form of isogonic, isoclinic, and isodynamic charts showing areas of like magnetic declination, inclination and force.

It will be of great interest and value to decipher the magnitude of the disturbing forces. For this purpose the northerly, westerly, and vertical components of the earth's magnetic

forces will be computed at each of the points of observation, and from this will be subtracted the values due to that part of the earth's magnetism which can be referred to a homogeneous magnetization. These residual quantities will show the complex distribution of the earth's magnetism and afford the basis for important scientific conclusions.

ELECTRICITY IN NAVAL LIFE.—IX.

BY LIEUT. B. A. FISKE, U. S. N.

AZIMUTH TELEGRAPHS.

FOR telegraphing azimuths, or ranges varying between, say, 0 and 12,000 yards, for connecting position-finders to the gun, or relocator positions in forts, or for any other class of work in which many separate signals are required, the system is extended as indicated in Fig. 26, A. It simply amounts to using two transmitters and two receivers on separate circuits. One transmitter and its receiver are graduated in degrees, while the other transmitter and its receiver are graduated in minutes. Angles as high as 120 degrees can by this method be telegraphed with great quickness and extreme accuracy, that is, with errors of much less than one minute of arc.

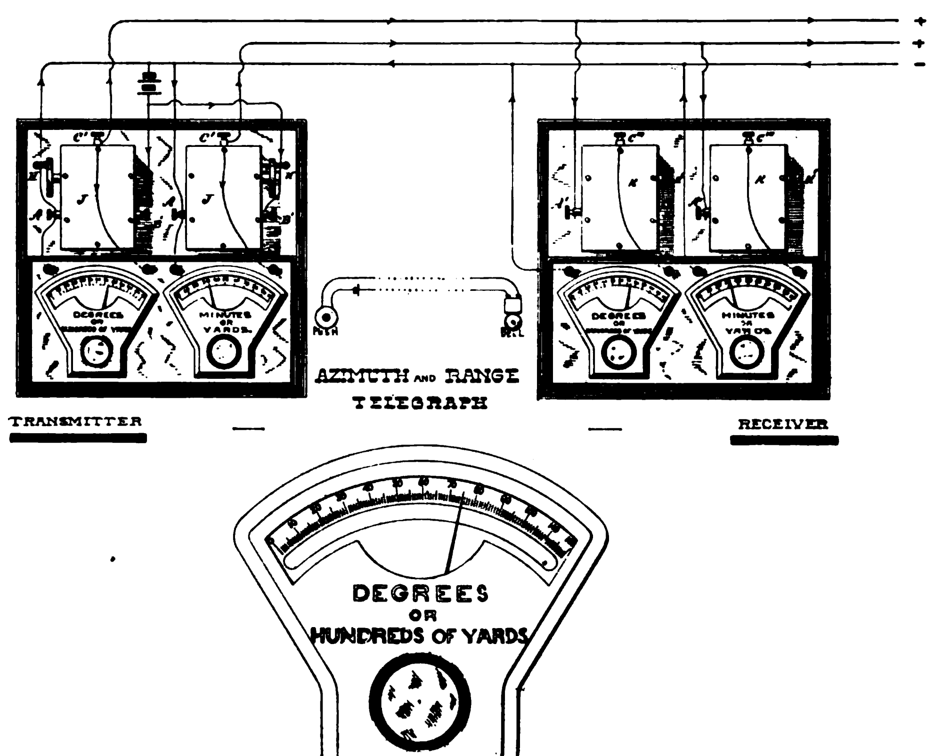


FIG. 26A.—AZIMUTH AND RANGE TELEGRAPH.

For signaling ranges which must be correct within one yard, between 12,000 yards and 0, the same plan can be used, except that the 120 graduations of the left-hand galvanometer mean, not degrees, but hundreds of yards; while the divisions on the right-hand galvanometer mean, not minutes of arc, but single yards.

Besides the accuracy and quickness of this system of telegraphing, one important advantage is that the circuit is always closed, so that all the connections and contacts are always made, and there is no making and breaking of the circuit. All the connections may be made ten times as strong and big and firm as is necessary, and even then they will not be very big, or take up much room; so that, if the system is kept in anything approaching good order. it will never break down in an emergency.

The same system can be used to telegraph orders to the turrets, torpedo-positions, gun positions, and other parts of a ship, as it is merely necessary to graduate the dials of the indicators suitably, in some such way, for instance, as that shown in Fig. 26, B. The system is about to be tried in the U. S. armored cruiser Brooklyn, for transmitting battle orders from the conning-tower to the forward and after turrets, the dials indicating such orders as a captain would wish to give to the

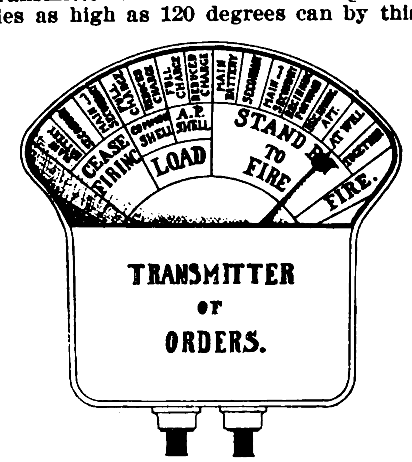
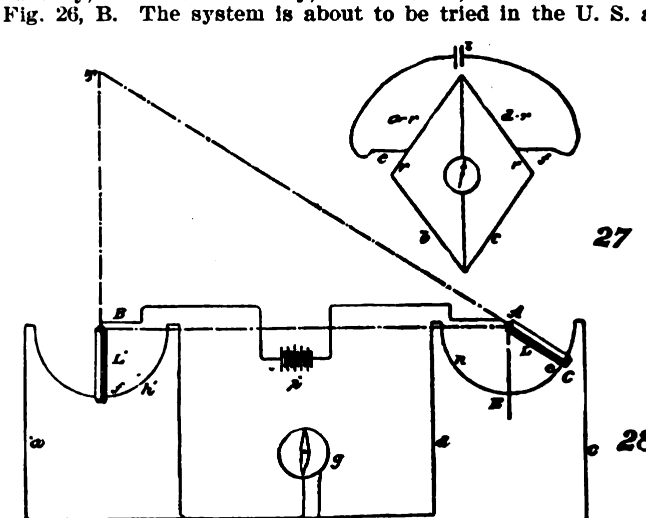


FIG. 26B.—TRANSMITTER OF ORDERS.



FIGS. 27 AND 28. THE RANGE FINDER.

turrets in an action, when noise would make audible signals impossible.

This instrument has now been tested for somewhat more than five years and has finally been adopted by the United States Navy. It has naturally undergone some changes during the process of evolution, and we now show the form which it has finally assumed. It will be remembered that the instrument is based, as far as the general principle goes, on the measurement of resistances of a conductor, in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, each arc corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the wire as the telescopes are turned in angle, to be pointed upon any object.

Let Fig. 28 represent the arms a and b of a Wheatstone bridge bent into the form of an arc h′, while c and d are bent into the form of an arc h, both of these arcs being wires of conducting material. Let telescopes, pivoted at A and B, be fitted with the contacts e and f. Now, if the extremities of the semi-circular arcs are in the same line, the contacts carried by the telescopes will press on the middle parts of their respective arcs, and the galvanometer will, therefore, not deflect, whenever the telescopes are parallel and at right angles to the base line, because ac = bd. But when the telescopes are parallel they are directed at some point in space infinitely distant; that is, the distance of the object towards which the telescopes are directed is infinite. The position of rest of the galvanometer needle is therefore marked "Infinity."

Now, let the telescopes be directed at some point T not infinitely distant. The telescopes will converge and the angle of convergence is clearly the angle ATB, or the angle CAE, which is measured by the arc CE. In other words, the degree of convergence is measured by the difference in the positions of the contacts of the telescopes on their respective arcs.

But, if the bridge was in balance when both contacts were at the middle points, it will clearly not be in balance when one is at the middle point of its arc and the other at C; and the amount by which it is out of balance will clearly vary with this difference of positions. That is, the greater the amount of convergence of the telescopes, the greater the deflection of the galvanometer; so that the deflection of the galvanometer varies with the angle ATB. By trigonometry,—

$$AT = \frac{AB}{\sin ATB} \times \sin ABT.$$

From this formula it is plain that, if ABT be a right angle, the distance AT varies inversely with the sine ATB; and it is, therefore, plain that, if the electro-motive force of the battery remains constant, the deflections of the galvanometer vary inversely with the distance; so that, if we know the length of base, we may graduate the galvanometer directly in units of distance, remembering that with such small angles as ATB always is in range-finding, the sine of the angle is practically the same as the arc.

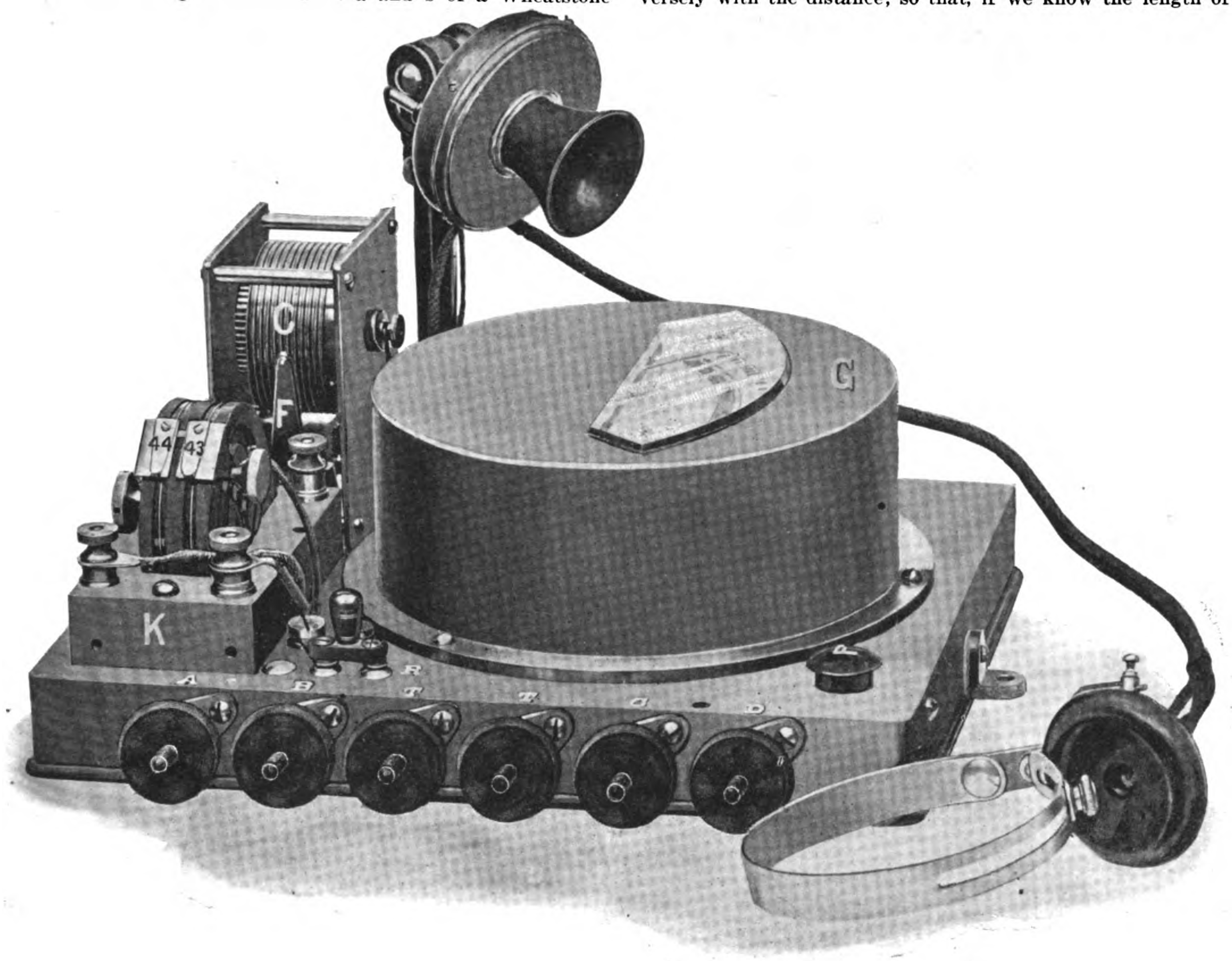


FIG. 32.—READING INSTRUMENT, RANGE FINDER.

But suppose that ABT is not a right angle. Suppose, first, that the target pointed at by the telescopes is infinitely distant, but in a direction inclined to the base. The contacts carried by the telescopes will not now press on the middle points of their arcs, but on points equally removed from the middle points. This is evidently the condition shown in Fig. 27, where the contacts have been moved away from the middle points over equal resistances. The galvanometer will not deflect, but will remain at its position of rest, which position on the galvanometer is marked "Infinity."

Let one contact be now moved from its position so that the telescopes converge and point at some object not infinitely distant. The galvanometer will deflect. In order to indicate the true distance of the object, the galvanometer must now deflect, not in proportion to sin ATB, but in proportion to

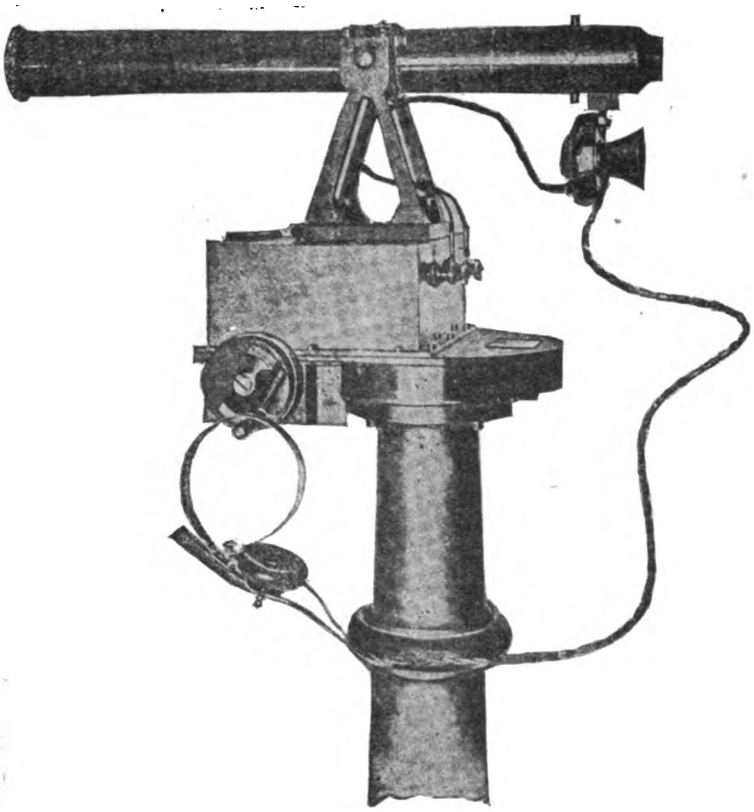
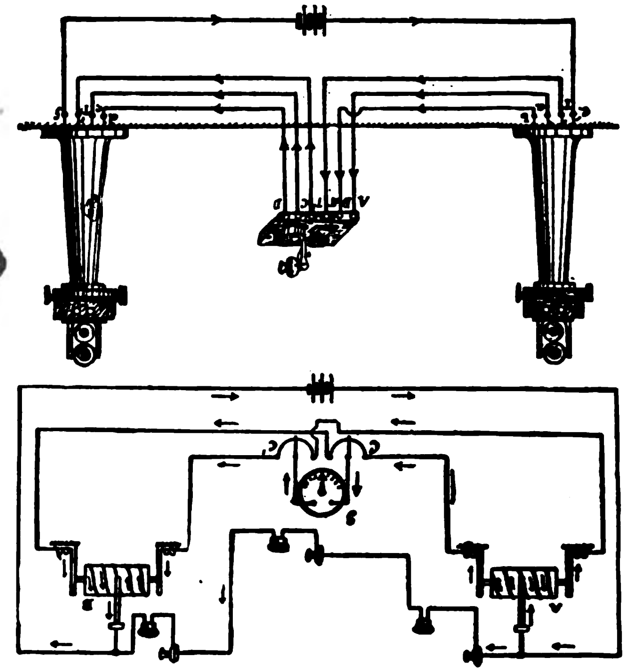


Fig. 29



Figs. 30 and 31.

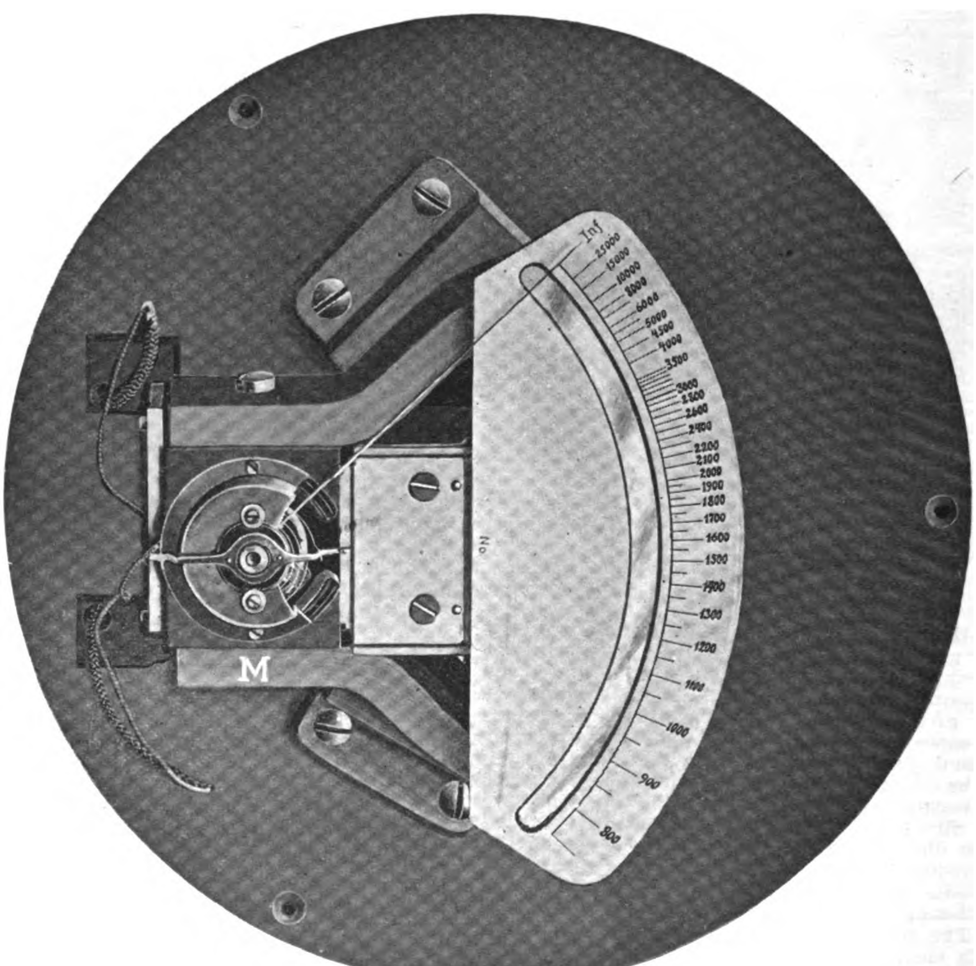


Fig. 33.—Interior of Galvanometer, Reading Instrument.

ATB ÷ sin ABT. In other words, it must deflect more for an angle of convergence ATB than if ABT were a right angle; and the smaller ABT is, the more the needle must deflect. In the range finder this increased movement of the needle is obtained by taking advantage of the curious fact that the current in the Wheatstone bridge increases as the contact points are moved away from the middle points. This is because the resistance of the bridge is less; so that, if the electro-motive force of the battery is constant, the current increases proportionally as the resistance decreases.

In the apparatus as at present constructed, the wire is not laid in the form of an arc, but is wound upon a cylinder of insulating material. A contact presses on this wire, and as the telescope above shown in Fig. 29, is turned in azimuth, the insulating cylinder revolves and causes the contact to press upon different parts of the wire. The special feature of value in this construction is that the wire is completely protected from the effects of weather, and, what is of more importance still, it makes it possible to use a device by which the non-uniformity of the wire is automatically corrected.

It has been said above that when the telescopes are parallel, and, therefore, pointing at some object infinitely distant, the contacts carried by the telescopes must press on the resistance wires at similar points; so that the galvanometer needle will not move from the infinity mark no matter at what angle the telescopes are pointed. In order that this may be always the case, it is evident that we must have an exact equality in resistance per unit length of resistance wires, or else we must have some device by which the non-uniformity will be corrected. This is accomplished in the instrument in question by a simple arrangement of the contact, by which, whenever the telescopes are directed at similar angles, the contacts automatically go to such parts of the wire that the bridge is in balance and the galvanometer indicates infinity.

Another important feature introduced in the present apparatus is a temperature corrector, by means of which any change of temperature, either in the climatic or other conditions, and its consequent effect upon the resistance of the circuit, is automatically compensated. In Fig. 30 the temperature corrector is shown at C C' and consists simply of two similar arcs of wire introduced in the circuit between the two observing instruments at the ends of the base line, upon which arcs press the contacts of the galvanometer G. In case the temperature of either instrument, say B, is raised and its resistance correspondingly raised it is simply necessary to move the two contacts of the galvanometer G along the arc C C', a distance sufficient to compensate for the increased resistance of that instrument. In order to tell when this sufficient distance has been traversed it is merely necessary to set both instruments at similar angles and move the two contacts equally on C C' until the galvanometer shows infinity.

This operation requires a few seconds only, and suffices to adjust the range finder for the temperature conditions which prevail that day. Fig. 31 shows a diagram of the circuit of the range finder. The two instruments at the opposite ends of the base line with their telescopes and telephones are shown. The arcs a and b of one instrument are connected to the arcs c and d of the other instrument, through the temperature corrector, which is mounted on the base of the reading instrument shown in the center. The telephones on the two observing instruments are connected together through the telephones on the reading instrument and the battery contacts are connected to the storage battery, shown below, which is ordinarily in the dynamo room of the ship. On the same base with the temperature corrector is the galvanometer or reading instrument. The captain of the range-finder crew is stationed in the conning-tower of the vessel or below the protective deck at the reading instrument and has all the devices for correcting the range finder under his hand. He has simply to see what figure the needle of the galvanometer points at and telegraph this figure to the guns, by means of the electric range indicator.

The details of the reading instrument are shown in Fig. 32; and the interior of the galvanometer, which is the principal part of the reading instrument, is represented in Fig. 33.

The shortest base lines with which this range finder has as yet been used successfully in practice, are in the New York and Indiana, in which the base lines are 46 and 44 yards respectively. In the Indiana, Massachusetts, Oregon and Texas, the forward observing instruments are mounted on a platform on the foremast, while the after instruments are at the after end of the superstructure. In the New York, both the observing instruments are on platforms on the masts; as is also the case in the Maine. In the other ships the observing instruments are usually secured on platforms built up from the deck, and on the conning-towers or pilot houses. In most ships, the reading instrument and the transmitter of the range indicator circuit are in the conning-tower; but in the Maine they are below the protective deck, which seems a better arrangement in a military sense. It would seem advantageous also to protect the observing instruments to at least as great an extent as the rapid fire guns. The average error, under conditions of service, with base lines of 45 yards, is about 1 per cent. for distances of 1,000 yards, 2 per cent. for distances of 2,000 yards, 3 per cent. for 3,000 yards, etc.

ELECTRIFYING A BIG BOILER IN TRANSIT.

A special dispatch from Calais, Me., of November 6, says: In Calais a huge boiler was being drawn through the streets to-day by sixteen horses, when the upper portion of it came in contact with overhead electric light wires, breaking them. Some of the wires caught on the boiler and the framework of the truck, and in an instant all the horses were knocked down. Several of them were killed. The men engaged in transporting the boiler received violent shocks, and several are dying. The accident caused consternation among the onlookers.

BICYCLE TRACK PUSH BUTTONS.

A new kind of bicycle race recently took place at Norway, Me. A board track 100 feet long and eight inches wide was built, and electric wires strung, with twenty-one buttons scattered along the length of the path. The contestants rode the narrow track and in passing ran over the buttons wherever possible. The winner managed to ring eleven of the twenty-one bells.

LETTERS TO THE EDITOR.

IS THE NUMBER OF ALTERNATING ARCS ON THE INCREASE?

In your issue of Oct. 7, you raise the question whether the number of alternating arc lamps in use is not increasing. This was called soon after to the attention of that department of our company under whose jurisdiction our lamp matters fall, with a request for a report.

The statistics covering sales of arc lamps revealed that at the present time the direct current long-burning arc lamp, seems to be most in demand. This is explained by the fact that the inducements of reduction in carbon expenses, and the saving in the item of trimming, have considerable weight with purchasers. The lamps have found an extensive use in lighting shop windows, theatre entrances, etc., heretofore lighted by incandescent lamps, and the same may be said of mill lighting—many orders having been received from silk, cotton and woolen mills, saw mills, paper mills, etc., etc.

A steady growing demand for alternating arc lamps was also shown, especially in the field of additions to and extensions of existing circuits. There are many cities and towns in this country in which two systems of lighting only are used—the series arc system and the alternating incandescent system. The arc lighting machines are invariably loaded to their utmost limit and any addition to the number of arc lamps would be undesirable if not impossible. On the other hand the alternating current machines do not carry their full load, and can, therefore, be called upon in case of further extension. This extension cannot, however, consist always of incandescent lamps, and the alternating arc lamp naturally solves one of the serious problems with which the station manager is called upon to cope.

More or less, perhaps rather more than less, difficulty has been experienced in developing a really good alternating current arc lamp. The nature of the arc lamp itself causes considerable humming, and as at first made, alternating current arc lamps were given to chatter beyond the bounds of tolerance when started. The lamp itself has also been considered as much more delicate to handle and more easily liable to get out of order than the ordinary lamp, and these beliefs, probably, more than anything else, may be considered as the explanation of the aloofness of the station manager.

But the demand existed, nevertheless, and each alternating current arc lamp connected to the circuits, served as valuable experience. Objectionable features were called to the attention of the manufacturers with that peculiar suavity which characterizes the station manager who sets up an ideal and cannot always obtain it—with the result that by a process of elimination the alternating current arc lamp has become a very excellent lamp.

Speaking for the General Electric Company, a very large number of its alternating current arc lamps were sold in 1896, and this number will probably be doubled in 1897. We, therefore, feel that we can concur with you in your belief that the alternating arc lamp is making great strides, although we are not yet prepared to say that relatively it is overtaking the direct current arc lamps. GENERAL ELECTRIC CO.

Schenectady, N. Y., Nov. 21, 1896.

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CONTENTS.

STORAGE BATTERY ROADS.

IT has long been a standing reproach to American electrical engineers that they have not succeeded in placing the storage battery on the same level of usefulness which has been found for it in Europe. This criticism has applied to the utilization of the battery in stationary as well as in railroad work. The causes which have operated to retard its progress in the United States are familiar to all who have followed the history of the art which, until quite recently has been, to say the least, a sad one. But it is gratifying to note the steady progress now being made in many directions in the introduction of storage batteries in central stations both for lighting and for railroad power work, while a distinct impetus has been given it in connection with isolated plants. It is no longer necessary, indeed, to cite European practice to convince our own central station managers of the economy which a storage battery can effect in any station subject to a variable load, as this has now been well established in the progressive stations in New York, Boston and elsewhere. But it is rather to another application of the storage battery that we desire to draw attention here and that is, to street car propulsion. A retrospective glance at this branch of work on American soil, it must be confessed, is not calculated to develop an exultant state of mind; but a strict analysis of the various experiments that have been made will, we believe, not be adequate to condemn the battery for this purpose; rather would it serve the very useful object of showing how not to do it. Let us, for a moment, rapidly review the situation. Beginning with a single car operated in Boston in 1887, all the experiments thus far attempted in the United States, with one or two exceptions, have been carried out with one or two cars. It is not within the nature of things that the economy of a storage car system can be even approximately predicated from the data furnished by the operation of such a small number of operating units, and hence, knowing the ingrained conservatism of street railway companies, the failure to introduce the storage battery need not be wondered at. Among the exceptions referred to above, the most extensive is the trial given to the system in New York several years ago when ten storage battery cars were operated for about six months. The exact figures on this attempt have never been made public, but it is safe to assume that the result was not sufficiently encouraging to the management to warrant a change in motive power. But even this more extended experiment was undertaken under conditions which could hardly have ensured success. To begin with, it will now be conceded, we believe, that the batteries were too light to cope successfully with the work they were called upon to do, while their construction, in the light of present practice, was not calculated to ensure longevity of the plates. Add to these disadvantages the fact that the cars were run on an old and battered track and over grades of considerable length and rise, and we have all the elements for a satisfactory explanation of an unsatisfactory failure in this case.

But at last we are to have what is believed to be the first real attempt to operate a storage battery street railway under conditions which are in every way favorable to success, and the description we give of the Englewood and Chicago road in this issue, gives a good idea of the manner in which the problem has been attacked. We have, to begin with, a power plant equipped with the most modern steam generating and utilizing apparatus which will be operated at practically a constant load, with every indication that an electrical horse power hour can be generated for 2 pounds of coal or less. The employment of three potentials obviates all unnecessary loss in rheostats or in the gassing of the batteries themselves, a by no means inconsiderable item in a large plant of this kind. Beyond the confines of the power house we find a track laid with 80-pound rails and ballasted with stone—truly ideal conditions, which will assuredly repay the interest on the investment in them by the power they will save in driving the car and in the freedom from shocks which the battery will enjoy. Add to this the level character of the road and we have almost perfect conditions for a storage battery railway. Barring the one uncertain factor, the life and cost of repairs of the battery cells, there would be nothing to prevent an unqualified prediction as to the success of this road; but even on this single point im-

portant as it is, one may look with confidence towards the outcome. The experience of the past has shown that a certain amount of metal is necessary to give the storage battery the requisite stability for this class of work and it may be assumed that the lesson has not been lost on the projectors of this road.

There has been no event in electric railroading since the introduction of the trolley itself, which will be watched with closer interest than this new Chicago enterprise. Its success seems fairly assured and if it is managed on the proper lines it will have a pronounced influence on future work of this kind. We wish those immediately interested in the experiment a full measure of success, but may be pardoned for venturing the hope that success in this instance may not lead to the undertaking of similar work where the conditions are not favorable or the equipment is not so thorough.

"ARE CENTRAL STATIONS DOOMED?"

UNDER the above somewhat startling head, the "Engineering Magazine" for December contains an article from the pen of Mr. Max Osterberg, which touches on a question that has of late furnished the text for writers both here and abroad. The question is one which will well bear discussion, as it may help to throw light on some points not heretofore fully considered in connection with the cost of operation of small isolated plants, while, on the other hand, it will serve to emphasize certain matters in central station operation which must sooner or later receive serious consideration.

In viewing the subject broadly one would suppose that to the central station would be conceded greater economy in generation of current while to the isolated, or block station, would be allowed the advantage due to the absence of heavy feeders, their attendant first cost and the loss entailed by them, in a word, the distribution losses. But Mr. Osterberg does not grant the central station even this advantage. He quotes Mr. Horatio A. Foster's able article in our pages, showing that it costs 5.4 cents to produce one kilowatt hour in some of our large central stations and then presents figures on a system of block stations, taking as a basis the supplying of an area of ten squares wide, that is, one hundred city blocks of fifty houses each, which area Mr. Osterberg places at "one-half square mile," a palpable slip of the pen, but which may have had an important influence on his estimates for the cost of feeders. On the assumption that the average house consumes 50 lamp hours per 24 hours, one block would require 2,500 lamp hours, or 137 kilowatt hours; or, allowing for necessary losses, 186½ kilowatt hours. Mr. Osterberg then assumes a coal consumption of 5 pounds of coal per horse-power hour, with coal at $3.25 per ton; attendance at $2.50 per day and oil, waste, etc., 50 cents, making a total daily expense of $4.81, or 2.31 cents per kilowatt hour. A similar calculation for gas at $1.25 per 1,000 cubic feet figures out at 4.22 cents per kilowatt hour. Mr. Osterberg concedes that in practice the figure he gives for operation with steam could not be reached, as no allowance was made by him for firemen's wages, the cost of banked fires, and for water tax, to which we may add the cost of repairs, depreciation, superintendence, cost of insurance of accumulators, and incidentals, all of which may materially alter his figures. Mr. Osterberg then goes into the calculation of the cost of an entire system of this kind. A single central station capable of furnishing the hundred city blocks with 250,000 lamp hours per day, with a fair chance of nearly 60,000 lamps burning at one time, that is, 30,000 amperes at 110 volts, would necessitate laying down a 4,500 horse-power plant. The feeder cost is placed at $500,000 laid; the site and construction of the power house at $500,000, and the boilers, engines and dynamos at $250,000 more; a total of $1,250,000. The cost of 100 block stations with gas engine and storage battery outfit is placed at from $12,000 to $15,000 apiece or $1,200,000 to $1,500,000; that is, about equal to that of the central station plant. Mr. Osterberg assumes that the cost of rent for these plants would be practically negligible inasmuch as the house in which the plant would be installed would be supplied with light at a proper rate, or would receive a certain amount towards the salary of the janitor, who would take care of the plant, for which each building would be charged pro rata.

Even assuming Mr. Osterberg's figures as to the cost of plants for the two systems to be correct, we think that he has taken too rosy a view of the cost of maintenance of the block stations to admit of a valid conclusion being drawn as to the relative economy of the two systems of operations. If, as he assumes, the underground system would cost $500,000, making an annual interest of $30,000 per year, and a cost to each of the five thousand buildings of $6 per year for the underground distribution, we are not quite so sure but that the janitors' fees in the case of the block system would not equal a like amount, that is, fifty cents a month. He has also left out of consideration the fact that the item of fire insurance in these plants would make a not inconsiderable item. They would certainly be classed as central stations and would be charged for as such. Indeed, it seems highly probable that decided restrictions would be placed by the insurance authorities on the operation of such plants, liable to so much individual carelessness, and that the insurance on contiguous property would be also affected unfavorably. Mr. Osterberg also assumes apparently that every one of the buildings in each block would take current, which past experience shows to be a very dubious condition.

As to the efficiency of isolated plants under which the block stations would have to be classed, there is still a deplorable lack of reliable information. We doubt if the owner of a single building operating an isolated plant is able to tell exactly what his lighting is costing him. Most of these buildings have steam plants for operating the lighting plants, as well as elevators, while in winter they are drawn upon for the heating of the building, and the difficulty of separating the costs of these various items is evidently very great. But if we read the signs of the times aright the owners of buildings are beginning to awaken to the fact that the supposed economy of their isolated plants is not always so great as they have assumed, and we know of more than one instance where large office buildings have been connected to the street mains.

Nevertheless there seems to be a tendency towards the installation of block lighting plants, and it would be well for central station managers to watch the progress in this direction closely. We do not by any means believe the central station is doomed. Mr. Osterberg's figures do not show any advantage of the block system over the central station system, even when the cost of distribution is included in the latter, while as to the cost of operation his own figures show that he has neglected a number of most important items. Besides he has assumed the distribution for the central station at low pressure. In this he has taken the most unfavorable conditions, as far as cost of feeders is concerned. As regards this point there is no reason why the central station of the future should handicap itself in such a way. Indeed, there is no good reason why the up-to-date central station should not distribute current in the same way as by the block system method. This would involve the construction of the central station at the water side, current generated by means of gas engines, driven by gas produced on the premises, distributed at high voltage to sub-stations in each block, or group of blocks, and there converted either by static or direct current transformers, with or without storage batteries. The system here outlined can hardly be termed one of the future, as it has, so far as the method of distribution is concerned, already gone into practical operation in several cases, a notable instance being the city of Budapest, where it has been found to be decidedly economical. We need only cite one more apparent oversight of Mr. Osterberg's, and that is the failure to allow for possible breakdowns. No central station could afford to deprive its customers of current for even a few minutes at a time, and maintain its business. This requires an installation of apparatus sufficient to tide over any trouble in any of the power or generating units. This means duplication of apparatus. In the case of a block system it would mean duplication of all power and electrical units, and would entail an expense not contemplated in Mr. Osterberg's figures. Taking all this into consideration we have no fear for the future of the central station, and the improvements which will be brought about will gradually lower the cost of current to a point, at which isolated plants will scarcely be thought of as a proper investment, within areas supplied by good central stations, unless other conditions come in to justify their installation.

CHRISTMAS STORE ELECTRICAL EFFECTS AND DECORATIONS.

We shall be glad to receive from any of our readers in central stations or isolated plants an account of work done specially for the illumination or decoration of stores and store windows at the holiday season. We are in receipt of inquiry on the subject, and it seems to us that an interchange of ideas and experience in this direction would be useful to all. If any photographs or diagrams of such work can be forwarded to us, it will be helpful.

Electric Transportation.

THE ENGLEWOOD AND CHICAGO STORAGE BATTERY RAILWAY.

NUMEROUS attempts have been made to operate street railways in the United States by means of storage batteries, but for one reason or another success has not attended the experiments. The reasons for the failures of the past may

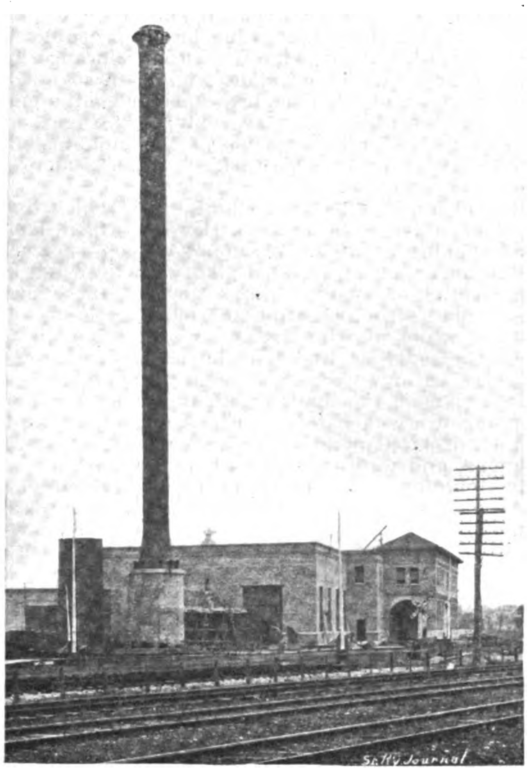


FIG. 1.—ENGLEWOOD AND CHICAGO POWER HOUSE.

not be far to seek, but enough experience has been gained to point the way how not to do it. It is, therefore, with no little interest that street railway men will watch the progress of the Chicago and Englewood road, which went into preliminary operation a few weeks ago.

THE ROUTE OF THE ROAD.

The route of the road is intended to be ultimately between Sixty-third street and the town of Harvey. At present, however, tracks are laid only to Blue Island, and this completed portion of the road will be first put in regular operation. The two cars now running travel from the power house at South Englewood to the northern terminus of the line.

The road begins at Sixty-third and Vernon avenue, right beside the Alley Elevated road's tracks. In order to land passengers at a station of the latter transportation line, the street car company has bought up a right of way through the block from Vernon to South Park avenue and will ultimately stop its cars along the sidewalk just at the foot of the stairway leading up to the elevated structure. As the Calumet Street Railroad Company also uses this point for a terminus, it is getting to be one of the centers of Woodlawn Park.

From Sixty-third street the route of the new road is straight south to South Chicago avenue, with a run of half a block on Sixty-seventh street. On South Chicago avenue the battery cars fall in line with the trolley motors of the Calumet system, which leaves the Englewood and Chicago's tracks at this point for a few blocks. When Seventy-first street is met, however, the route turns sharply to the west and runs toward Auburn Park as far as State street, where it is within a couple of blocks of the Chicago City Railway's trolley lines.

From Seventy-first and State streets the tracks run due South along the newly paved thoroughfare which promises in time at this end to maintain the reputation for business it holds in the downtown district. At Seventy-ninth street another turn is made to the west, until the Vincennes Road is reached at the southernmost point of the City railway's system. Except for a small twist to the west on Eighty-first street, where both the Chicago and Western Indiana and the Chicago, Rock Island and Pacific tracks are crossed, the general course of the line is then to the southwest along the Vincennes road to Western avenue in Blue Island. Then the latter street is followed south to the present terminus at the railroad crossing in the heart of the town.

A spur line, to act as a feeder, runs from the junction of the Vincennes road and Morgan avenue west on the latter street through Morgan Park. It ends at Mount Hope Cemetery after skirting the edges of Mount Greenwood and Mount Olivet Cemeteries. Other feeders are projected to connect with various points in Englewood, Pullman, Kensington, Roseland and Auburn Park. At present over twenty-one miles of track are laid, of which nine miles are double track and three single track.

TRACK CONSTRUCTION.

The road is equipped with eighty-pound Johnson seven-inch girder rails. These rest on eight-foot ties provided with tie-plates, laid every two feet along the route. The whole is put on a foundation of six inches of slag or crushed stone, and this was not laid until the street had been settled by a steam roller. Six-bolt fishplates are used at the joints, and tie rods every thirty-three feet. Altogether the track, with its absence of bonding wires and heavy construction, appears more as if designed for steam traffic than an electric street car line.

Along the route of the new line carriage roads have been made for the residents. A large portion of the way is though swamps and over prairie ground, where the only thoroughfares were cleared spaces in the mud. They have now developed into well-paved streets at the expense of the street railroad company, which, it is estimated, has spent in the neighborhood of $25,000 for carriage road building alone.

THE POWER HOUSE AND CAR BARN.

The power house and car barn shown in their present condition on this page, Fig. 1, are located at Eighty-sixth street and Vincennes Road, just beside the curve of the Rock Island Railroad's suburban line at South Englewood.

The building, as at present standing, is 175 feet long by 102 feet wide, and beside the power arrangements will hold twenty-eight cars in shelter. When at its full size it will be 258 feet long by 102 feet wide and will hold comfortably the fifty cars ultimately intended to be in service. These are to be stored on tracks in the car barn part, and will be put there by a large electric transfer table running the entire length of the building and connecting the outside tracks with those in the interior of the building.

The new offices at the power house, which are situated over the front porch, will be ready for occupation in less than a

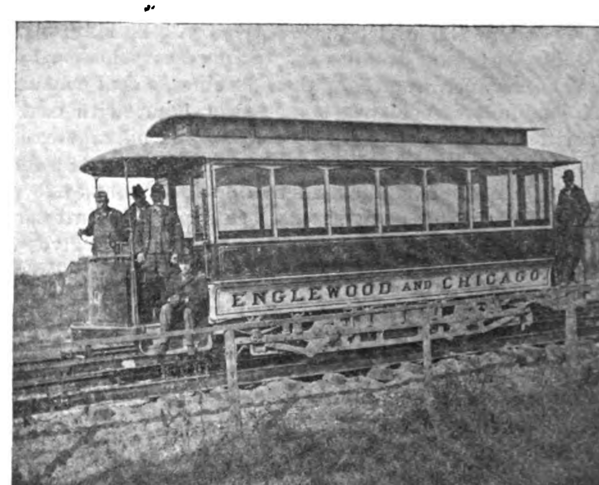


FIG. 2.—ENGLEWOOD & CHICAGO STORAGE BATTERY CAR.

month's time. They will comprise a private and large general office, and on the same floor will be a reading room for conductors and motor men, a room with lockers, shower baths and toilet rooms, and also a waiting room.

THE BATTERY-CHANGING ARRANGEMENTS.

The tracks leading from the street into the car barn are so arranged that the cars may be brought into the building from

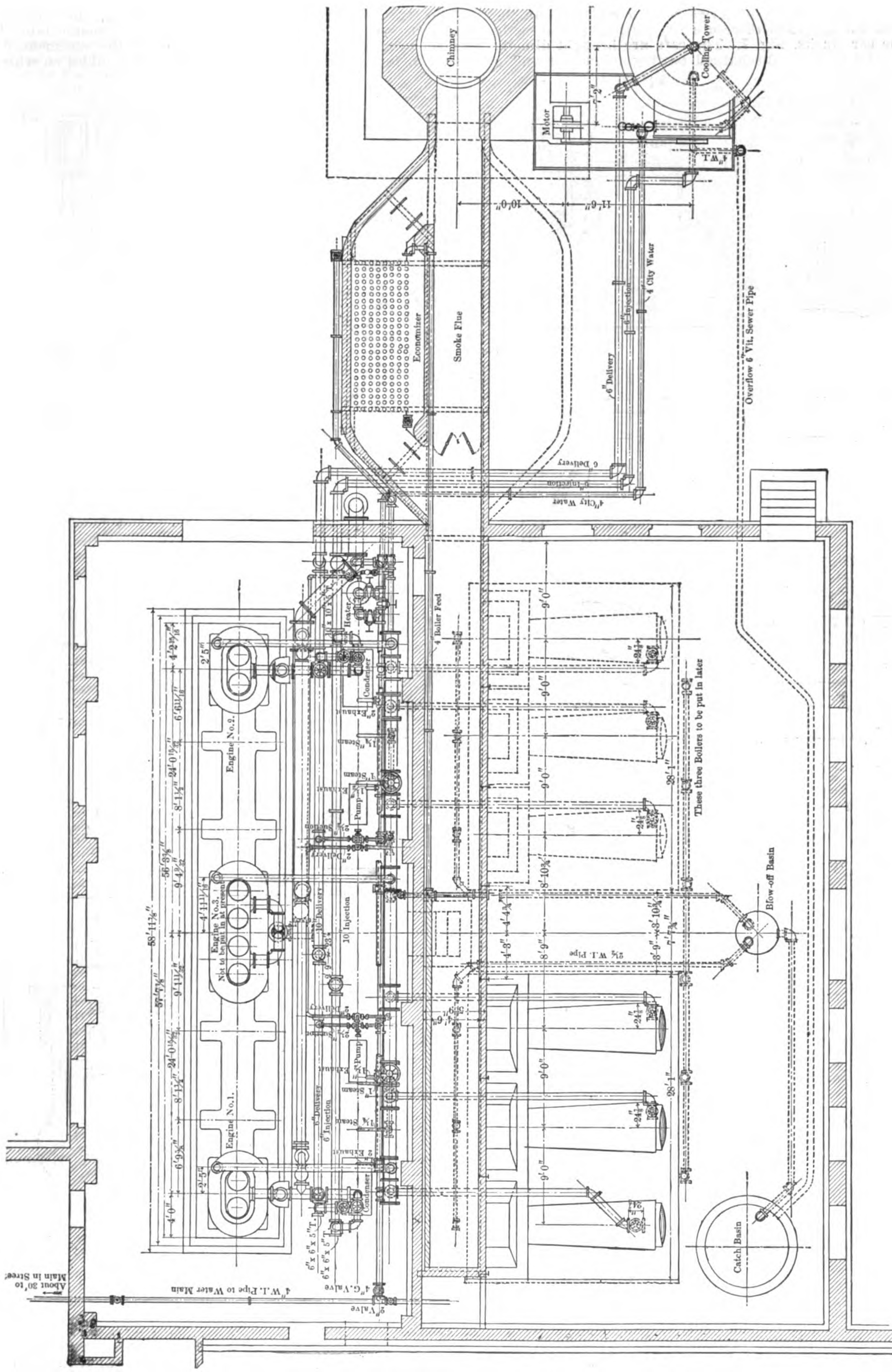


Fig. 7.—Power Plant, Englewood & Chicago Electric Street Railway Co.

either direction, so that the batteries may be replaced. In the front part of the car barn there are two battery pits directly beneath the car tracks, Fig. 7. The cars are brought directly over these pits and the discharged battery taken out and a charged battery put in its place. This operation will require not more than two minutes, so that the delay is not serious.

The batteries are handled by a battery transfer elevator shown in Fig. 3. This device consists of a car operated by **an electric motor and having on each end a platform provided with rollers on which the battery tray is placed when being moved or raised into position under the cars. There are two of these elevators in the car barn, one at each side.**

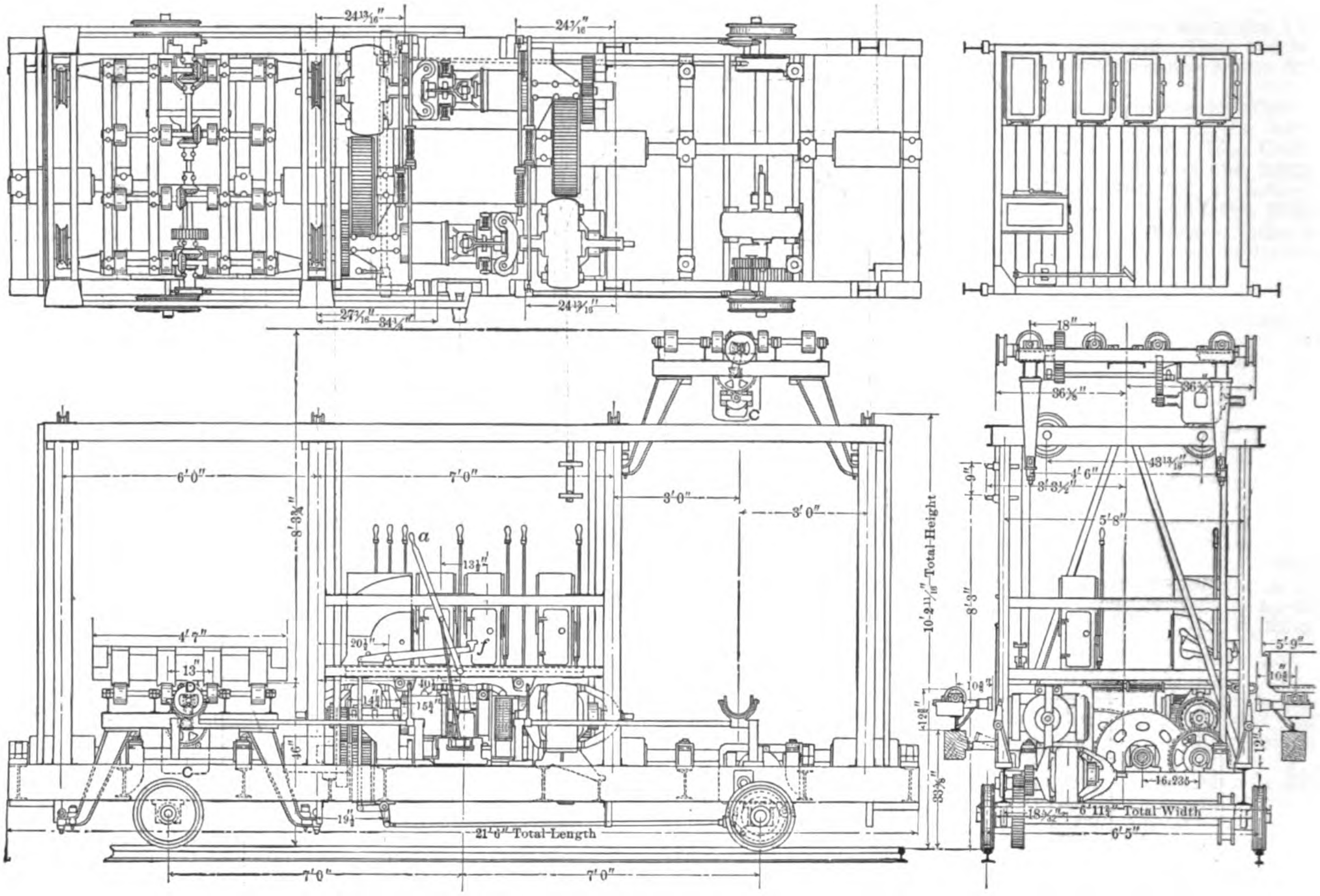


FIG. 3.—BATTERY ELEVATING AND TRANSFER TABLE, ENGLEWOOD & CHICAGO ELECTRIC STREET RAILWAY CO.

The arrangement of the battery room in which the trays are charged, is also shown in Fig. 8. The battery transfer table is shown running on rails in the lowest part of the basement, directly under the cars. The frames or charging tables on which the batteries are placed for charging, are at either side of this transfer pit. These charging tables are provided with rollers similar to those on the transfer elevator and a clutch coupling is arranged so that the rolls on the elevator may be coupled **to the rolls on the charging tables. These rolls are operated by electric motors controlled by the operator who stands in the center of the battery transfer table. The battery trays are raised and lowered by means of electric hoists at each end of**

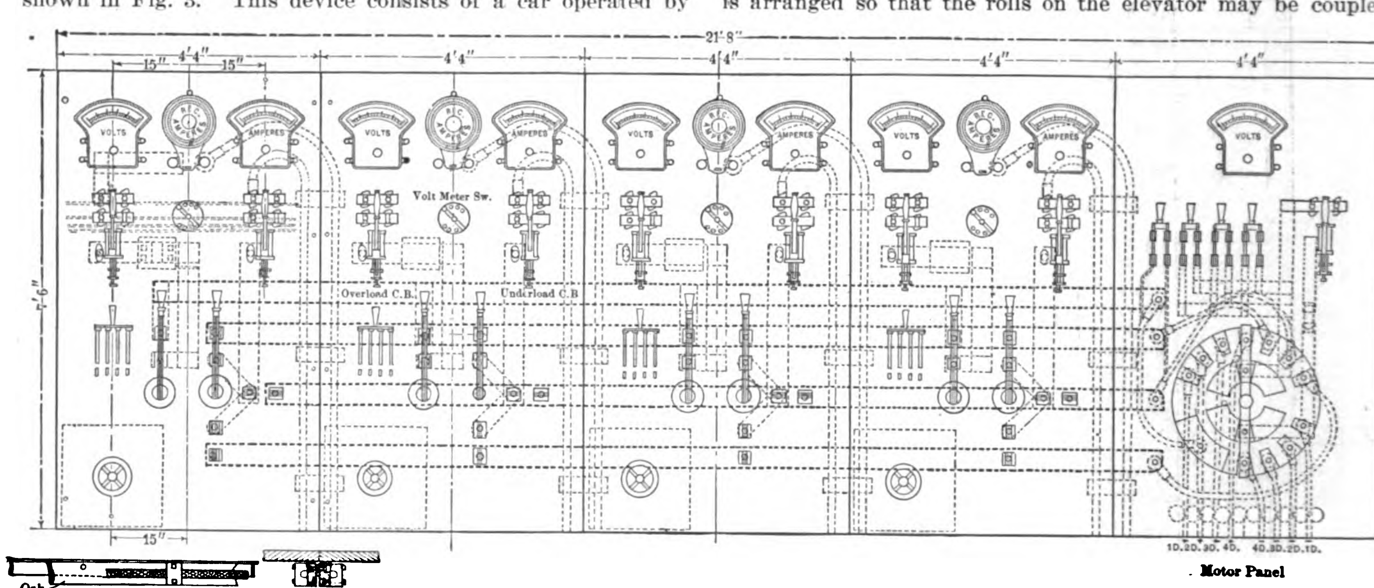


FIG. 4.—BATTERY SWITCHBOARD, ENGLEWOOD & CHICAGO ELECTRIC STREET RAILWAY CO.

the battery transfer car. In the engraving the platform carrying the battery is shown at its lowest position on one end, and raised to the highest possible position on the other end. There are five motors in all on the transfer car, all operated by one attendant. This battery transfer car has been furnished by the Shaw Electric Crane Company, of Muskegon, Mich. It is one of the most important features of the plant, for on its successful operation depends in a great measure the success of the system. At night all the cars are taken into the car barn by means of the car transfer table and run into their respective tracks above the battery pit where the batteries can be replaced so that the cars will be ready for service the next day.

THE POWER PLANT AND METHOD OF CHARGING.

In charging the batteries three voltages will be used, the aim being to charge the batteries at nearly a constant rate during the entire period of charge. The discharged cells will be connected, first, to the low pressure omnibus bar, and then as their electromotive force rises they will be connected successively to the next two higher voltages. In this manner the batteries are to be charged in the most economical way without the loss of energy in resistances or in counter electro-motive force cells. It is the intention to operate three generators of different voltages all the time. Figs. 5, 6 and 7 show the arrangement that has been adopted for

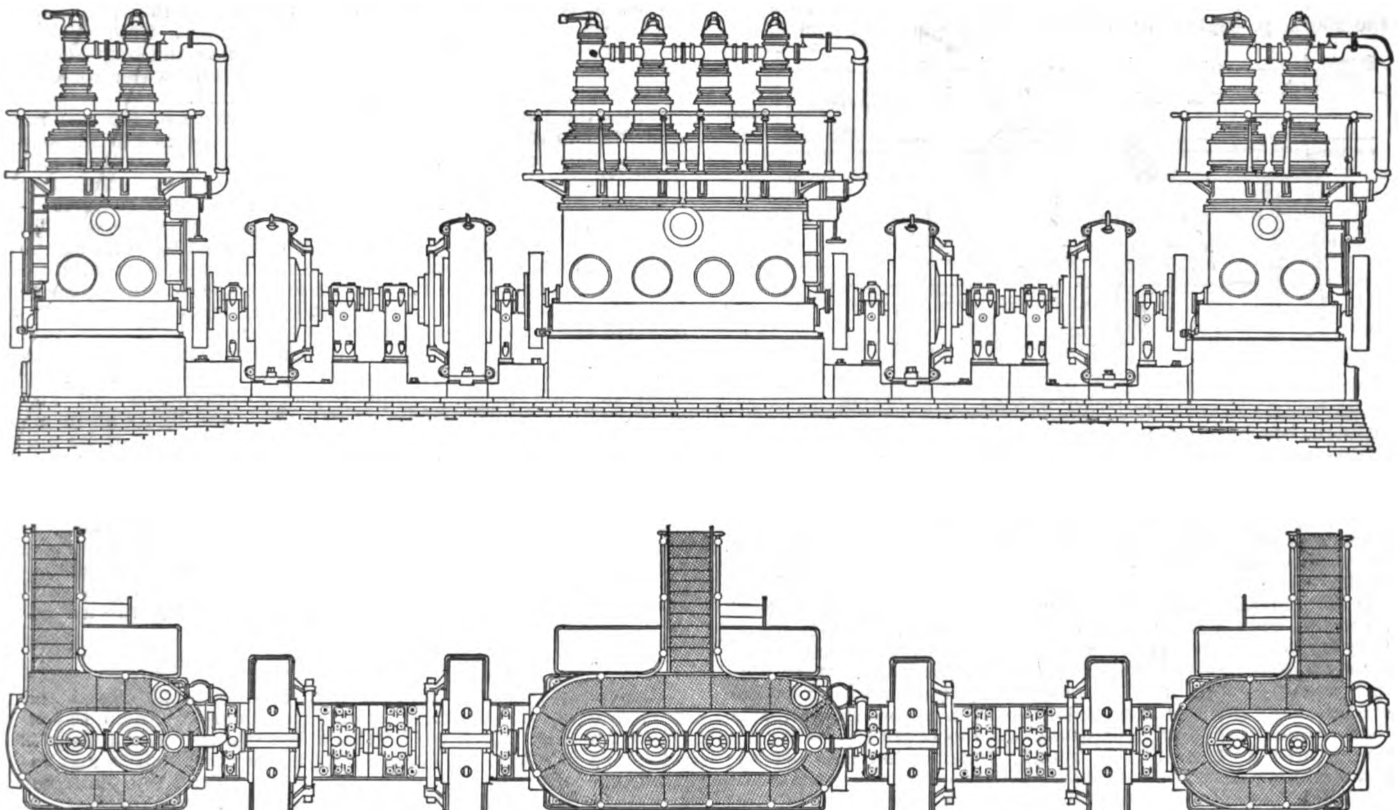


Fig. 5.—Engine and Dynamo Arrangement, Arnold System, Englewood & Chicago Electric Street Railway Co.

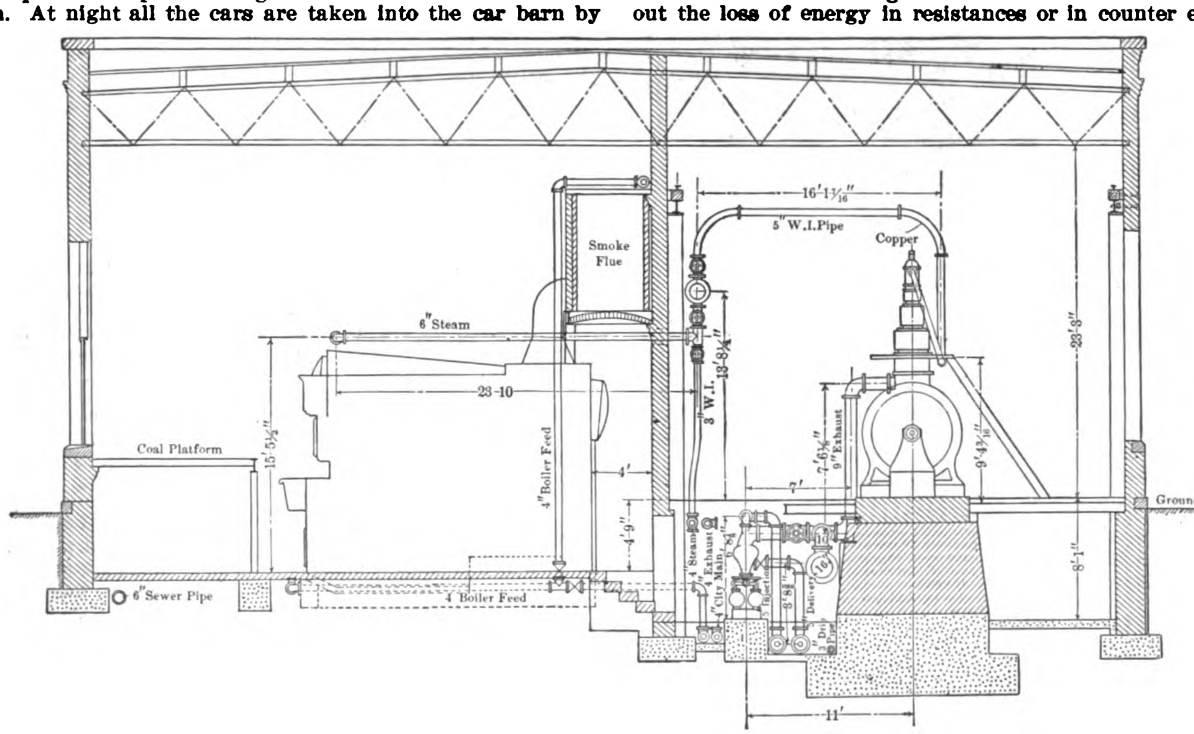


Fig. 6.—Elevation of Piping for Power House, Englewood & Chicago Street Railway Co.

the engines and dynamos. The plant consists of four 250 k. w. Walker generators and three Willans triple expansion engines running at 380 r. p. m. These units are connected according to the "Arnold system," so that it is possible to operate any one or all four of the generators from the large 500 h. p. engine in the middle, which will be installed later, while either of the 250 h. p. engines at the ends of the shaft can run either,

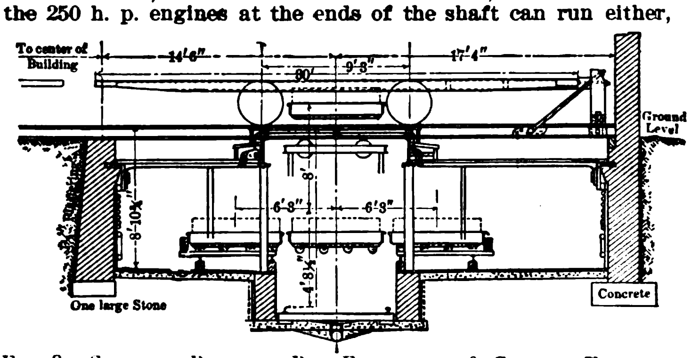


Fig. 8.—Storage Battery Pit, Englewood & Chicago Electric Railway Co.

or both, of the adjacent generators. The conditions call for the operation of three generators most of the time, and it will be seen that by this arrangement it is possible to run three direct conected generators with one engine, while at the same time ample capacity of both engines and generators is held in reserve in case of a breakdown. The entire plant of 1,000 h. p. of engines and generators occupies a space only 55 feet long by 12 feet wide.

It is evident that by the adoption of the "Arnold system" there has been secured a power plant of less first cost and occupying much less floor space than one designed along the usual lines of independent direct connected units. In the latter case to secure the same reliability and capacity of the present arrangement it would have been necessary to install four engines and four generators. In the operation of such a plant three units would be runnig underloaded most of the time, while with the plant shown it is the intention to operate the 500 h. p. engine in the middle at its full capacity and thus at its maximum efficiency. As the dynamos generate directly three different voltages, no boosters will be required in the plant.

The complete boiler equipment consists of six 200 h. p. Heine boilers, of which three are put in at present. These boilers are equipped with the Roney stoker. An iron platform is built directly in front of the boilers at such a height that the coal may be shoveled into the hoppers of the stokers without raising it. The coal is shoveled directly onto this coal platform from the cars on the side track outside the building.

A Greene fuel economizer, consisting of 192 pipes, is provided in the smoke flue to heat the feed water before it enters the boilers. A steel self-supporting smokestack, 150 feet high, is furnished by the Variety Iron Works, of Cleveland. This stack sets on a brick base about 22 feet from the ground, the smoke flue entering this brick base.

The Green economizer acts, as it were, as a storage battery for the boiler plant. There is always the large reserve of water above the evaporated point in the economizer ready for use in the boilers, and by means of this reserve the firemen are able to keep the steam constant and work the boilers at their greatest efficiency. The economizer, for this reason, makes a considerable saving above the actual saving that is due to raising the temperature of the feed-water.

The engines will be run condensing and all condensers and boiler feed pumps have been furnished by the Worthington Company. A cooling tower has also been erected by the same company for cooling the water after leaving the condensers. The water from the condensers is pumped to the top of the tower, where it is formed into a spray, and drops through a series of sewer pipes placed on end in the tower. Through these sewer pipes a draught of air is forced by means of a blower in the base of the cooling tower. The evaporation of the water is sufficient to cool its temperature, so that it may be used over and over again in the condensers. This cooling tower was used, as the city water main was the only source of water supply, and the expense of using city water for condensing purposes would otherwise be too great.

While the batteries are being charged, three of the generators will run continuously; one at 150 volts, one at 170 and one at 190. The batteries will be first run on the 190 volt circuit, the batteries being connected successively to the other two voltages. The mains in the car barn are run on a compensating system, so that the voltage at any battery is the same in any part of the building. This is accomplished by running the positive mains clear around the building in one direction, while the negative mains are run the same distance in the opposite direction. The current to any battery, therefore, is obliged to traverse the entire circuit of the building.

An ingenious device has been designed to indicate to the attendant in the battery room when the batteries are fully charged. This piece of apparatus is practically an ammeter, with a device which makes contact and lights an incandescent lamp when the current has dropped to 25 or 30 amperes. The operation of this instrument is as follows: When the batteries are first put on the charging circuit, their e. m. f. is low and the amount of current which they will take is correspondingly large. As the voltage of the battery rises, the amount of current which may be run through it is decreased until the voltage has become sufficiently high. The instrument is adjusted so that a contact is made at this point and an incandescent lamp is lighted up, thus warning the attendant that the battery is charged.

THE CAR TRUCK AND BATTERY EQUIPMENT.

The car equipment will consist ultimately of 20 closed and 20 open cars built by the St. Louis Car Company, mounted on Dupont trucks. Each car carries a battery tray containing 72 cells, 8 by 5 inches, by 18 inches high, weighing 4 tons and capable of delivering 400 amperes at 150 volts. The batteries are furnished by the Electric Storage Battery Company, of Philadelphia, and are designed especially for traction use. The two cars now running with these batteries have been in use for a little over a year in New York City, and the batteries are still in good repair. These cars are at present in regular service on the line of the road, having been brought on from New York. The Dupont truck is shown in Fig. 9.

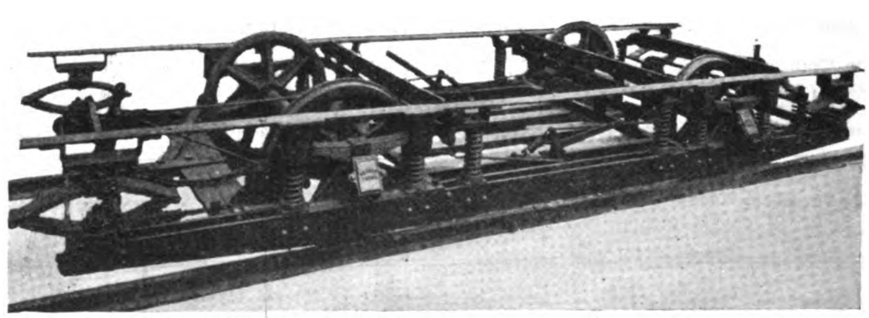


Fig. 9.—Dupont Car Truck, Englewood & Chicago Electric Street Railway Co.

Contact plates are fastened on the sides of the battery tray, so that when it is raised in position on the car, connection to the controller wiring is immediately made. A detail of the spring contact on the car, is shown in Fig. 10. Similar contact devices are provided at the sides of the charging tables in the battery room, so that as soon as a battery tray is put in position, it is ready for charging without further trouble.

The battery tray is supported on the cross-bars between the wheels of the truck. There are four 5-inch channels under this battery tray which serve to support it, these channels being bent up at the ends and formed into hooks. Fig. 9 shows the truck with these channels in position, hanging from the cross-bars. There will be one 50 h. p. Walker motor on each truck. The latter is provided with both a handbrake and friction brake, the latter being composed of two discs; one of each is keyed fast to the axle, the other being forced against it by the motorman when it is desired to stop the car. This winds up a chain, thus applying the brakes. Owing to the extra weight of these cars, this increased brake power was thought necessary.

THE MANAGEMENT.

Mr. G. Herbert Condict, the general manager, upon whom

the heaviest part of the work of the construction of the road devolved, made great and most creditable progress during the spring and summer months of this year, and had frequent consultations with Mr. B. J. Arnold, Chicago, who is consulting engineer to the company, and also with Mr. J. H. Vail, of Philadelphia. Mr. Condict has also received very able assistance from Mr. Hugh Hazleton, a young and energetic engineer who makes his headquarters at the power house.

When completed this plant will be one of the most up-to-date

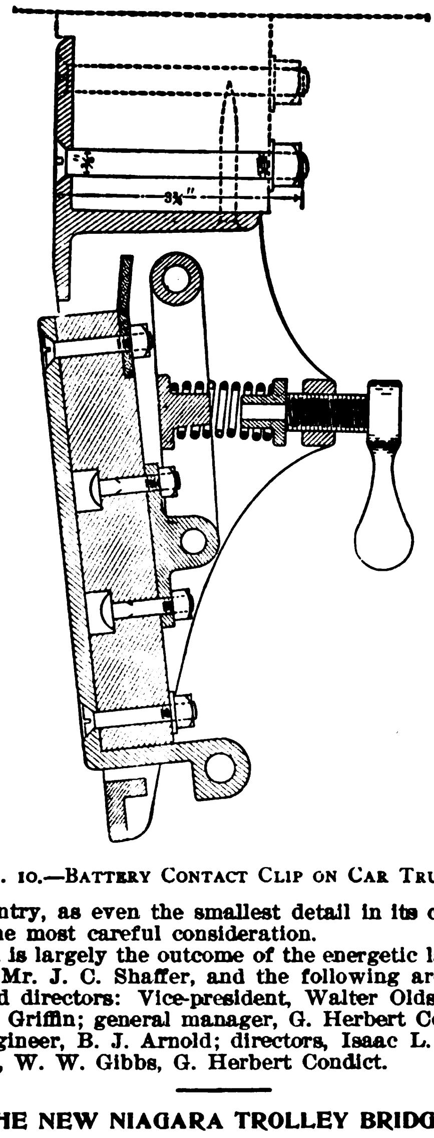


FIG. 10.—BATTERY CONTACT CLIP ON CAR TRUCK.

in the country, as even the smallest detail in its construction has had the most careful consideration.

The road is largely the outcome of the energetic labors of its president, Mr. J. C. Shaffer, and the following are the other officers and directors: Vice-president, Walter Olds; secretary, Charles F. Griffin; general manager, G. Herbert Condict; consulting engineer, B. J. Arnold; directors, Isaac L. Rice, Herbert Lloyd, W. W. Gibbs, G. Herbert Condict.

THE NEW NIAGARA TROLLEY BRIDGE.

BY ORRIN E. DUNLAP.

IT is highly probable that the first trolley car to enter the Dominion of Canada from the United States on its own track and by its own power will cross the Niagara gorge when the fine new steel arch bridge, now in course of construction, is completed. This bridge will be one of the finest structures of its kind in the world, and the work of erecting it is attracting much attention in engineering fields. Mr. L. L. Buck, M. Am. Soc. C. E., is chief engineer in charge of the work, and the Pennsylvania Steel Company has the contract for the superstructure. The new arch will replace the railway suspension bridge over which the Grand Trunk, Lehigh Valley and Erie trains run. The lease, however, is held by the Grand Trunk, and the new bridge will greatly increase this company's facilities in crossing the Niagara chasm.

The arch will have a span of 550 feet between the end piers, and it will be connected to the top of the bluff by a trussed span 115 feet in length. The main span will be formed by an arch with horizontal upper chords.

The bridge will have two floors or decks. The upper floor will be devoted to steam railway purposes, and will contain two tracks. The lower floor will have walks for pedestrians, carriage ways and trolley tracks.

The load the bridge is expected to carry is enormous. It is designed to carry on each railroad track a load of two locomotives, with four pairs of drivers each and 40,000 pounds on each pair, followed by a train of 3,500 pounds per foot. This would make 7,000 pounds live load on the upper floor, but in addition to this the bridge is designed to carry a live load of 3,000 pounds per running foot on the lower floor, making no less than 10,000 pounds live load in all. This, as intimated, forms an unusually heavy load for a bridge.

It will surprise many to learn that while the new arch is being built the old railway suspension bridge will remain in daily use, and is not expected to in the least interfere with the labors of the construction gangs. To build a bridge of the size proposed arch is a task of no small magnitude, but to put it right on the site of a bridge of different design increases the task in no small degree. But this is just what is being done at Niagara, and the way it is done is that the end spans and first panels of the arch will be built on the scaffolding in place. Then the end spans will be connected with the end post of the arch, and by the approach girders, with the temporary anchorage, when the two parts of the arch will be built out by cantilevers. The upper floor beams of the arch will be left out until the old structure can be raised high enough to allow the new beams to be inserted under the upper chords of the old bridge. While this is going on the suspension bridge will rest on the lower floor beams of the new arch, and therefore the towers and cables of the suspension bridge can be removed. When this point of progress is reached the suspended structure will have to be shoved far enough to one side to allow the laying of one track on one pair of the new stringers, and after the old bridge has been wholly removed the second track can be placed and the work hurried to completion. As a franchise for the erection of a new bridge at Lewiston has been granted by the Legislature, it is proposed to remove the old suspension bridge to that point and there re-erect it.

BOSTON WEST END FIGURES.

The West End (Boston) Street Railway Company reports for the year ended September 30, 1896: Gross earnings, $8,341,958; ditto 1895, $7,746,170. Increase, $595,788. Operating expenses, $6,334,619; ditto 1895, $5,633,163. Increase, $701,456. Net earnings, $2,007,339; ditto 1895, $2,113,007. Decrease, $105,668. Fixed charges, $794,601; ditto 1895, $746,964. Increase, $47,637. Balance, $1,212,739; ditto 1895, $1,366,044. Dividends, $1,147,950; ditto 1895, $1,102,525. Increase, $45,425. Surplus, $64,789; ditto 1895, $263,519. Decrease, $198,730. The car mileage run for the year ending September 30, 1896, has been 25,841,907 miles, an increase of 3,661,782 miles. The number of revenue passengers carried has been 166,862,288, an increase over the preceding year of 11,630,782. The number of employés in all departments is 4,750.

LONG ISLAND R. R. ADOPTS ELECTRIC LOCOMOTIVES.

President Baldwin and other officials of the Long Island Railroad have been considering for months the feasibility of electricity as a motive power, and are convinced that old-fashioned locomotives can now be supplanted by electric motors. It is not intended to use the motors to run to distant points of the island, but to nearby places, such as Jamaica, Flushing, Mineola, Far Rockaway, College Point and Manhattan Beach.

President Baldwin says: "There is no doubt that the motors have arrived at such a stage of perfection that they can be used with benefit to our patrons and the road. We will go slow in the matter, because simplifying improvements are being made every day, and we want the best in the market. I think some of the motors will be in operation next summer."

UNDERGROUND ELECTRIC RAILROADING IN LONDON.

A meeting of the Metropolitan District Railway Stockholders' Association was held on Nov. 20, in furtherance of the project for constructing two deep level tunnels for an up and down service of express electric trains between Earl's Court and the Mansion House. The stockholders have indorsed the action of their directors in approving the scheme, and the necessary powers will be asked for at the coming session of Parliament. That they will be granted is a foregone conclusion. Parliament has already sanctioned six metropolitan underground projects, and two will be sanctioned at the forthcoming session. There are still others in the air, all electrical. Most of these lines are planned to rectify the extraordinary want of foresight which practically forbade the termini of the great

railways to advance beyond what were, in the days of their building, the suburbs of London. The result has ever since been that the traveler consumes as much time in getting from one great terminus to another on the other side of the metropolis as would suffice to carry him fifty miles on his journey.

TELEPHONY AND TELEGRAPHY.

CAILHO'S SYSTEM OF SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

IT was M. Van Rysselberghe who first pointed out a feasible method of utilizing telephone lines for the transmission of telegraphic signals during transmission of telephonic messages. This he accomplished by an arrangement of apparatus by which the telegraphic signals are graduated as to the rise and fall of current strength, so that while still able to actuate the telegraphic apparatus they are powerless to influence the telephone diaphragm. There were, however, certain inherent faults in the Van Rysselberghe system which it has been the aim of several subsequent inventors to overcome, and among them we may mention Maiche, Picard, Jacob, and latterly M. Cailho, who, according to the "Journal Telegraphique," has solved the problem in a most elegant manner.

M. Cailho, while taking as the basis of his system the use of the metallic circuit for the telephonic transmission and the system of two wires connected in parallel for the telegraphic, like Maiche and Picard have done in the past, first employed the Van Rysselberghe graduators, inserted in each of the wires; but he very soon replaced this device, disturbing to rapid telegraph signal transmission, by a simple coil with two circuits.

The arrangement of M. Cailho is shown in Fig. 1. The coil consists of two windings, a and b, of two exactly identical wires, carefully insulated one from the other, and wound simultaneously on the same core, consisting of a bundle of annealed and paraffined iron wires. The telegraphic impulses divide at the point, v, into two equal parts and traverse the two windings in opposite directions with respect to the axis of the solenoid. Consequently the effect of self-induction will be almost nil. The case is different, however, for telephonic currents. It will be seen that in the latter case the telephonic currents which tend to pass into the coil would traverse the two windings in the same direction. The bobbin would then act as a coil of high self-induction with respect to these currents, so that the latter are transmitted almost with their full strength on the line. It results from this that the telephonic currents are stopped by the coil, which, on the other hand, does not in any way interfere with the telegraphic signals.

In order to avoid the effects of the extra current of rupture

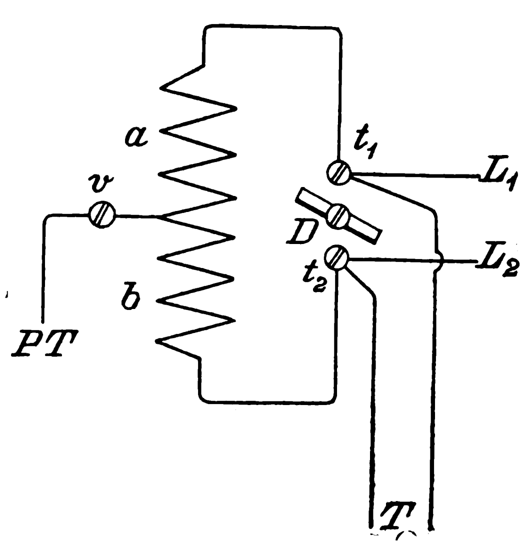


FIG. 1.

at the end of each telegraphic signal, which may in certain cases prove disturbing, M. Cailho had already, in 1890, suggested the use, and sometimes the necessity, of putting a condenser in shunt to the telegraph transmitter PT, the object being to prevent the click in the telephone which is heard the moment when the point, v, is insulated from the battery by the action of the telegraph key. However, this action only manifests itself with a coil in which the resistance is considerable, as related to the self-induction, but without seriously interfering with conversation. As a matter of fact, M. Cailho states that not a single telephonic circuit leaving Paris has any condenser in shunt. This is a great advantage, as con-

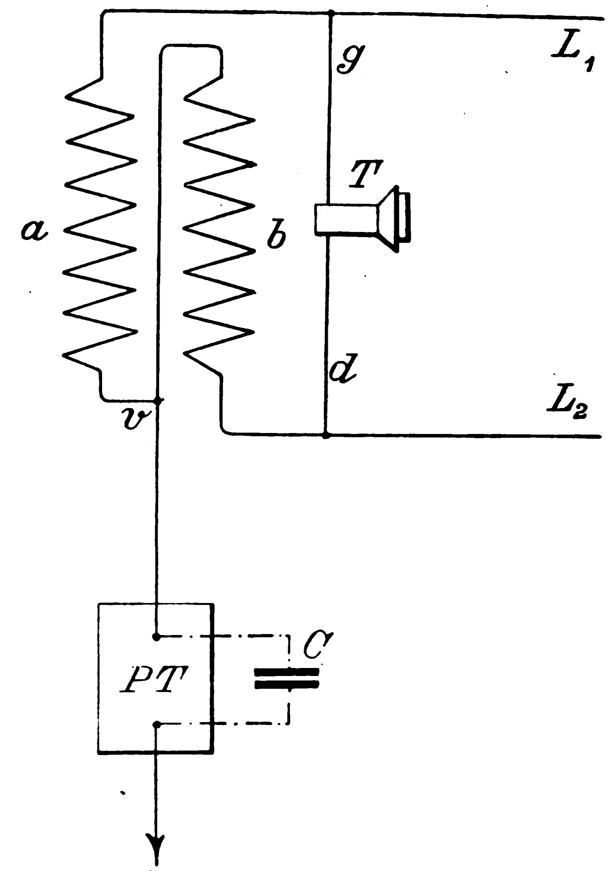


FIG. 2.

densers necessarily have to be provided with very sensitive lightning arresters, which were the principal bugbear in the Van Rysselberghe system.

The latest coils used by M. Cailho, made by L. Digeon & Co., of Paris, have 300 ohms resistance, and 6,800 turns for each wire. The latter of German silver has a diameter of 0.22 mm. For this model of coil M. Cailho has separated the two windings, winding one on each half of the core. By this arrangement the two telephonic circuits do not absolutely annul each other, but in practice for lines of small importance this method of construction is adequate, and much simpler than the one cited above. The following electrical and magnetic details of the coil are given:

SELF-INDUCTION.

Winding a (b, insulated).................	4.92	Henry
Winding b, (a, insulated)	4.91	"
a + b	14.60	"

RESISTANCE.

Winding a (b, insulated)..................	299.92	ohms
Winding b, (a, insulated)	299.93	"
a + b	599.85	"

The coil, not including the end piece, is 7 cms. long and 4 cms. thick for each winding. The core is 3 cms. in diameter. The apparatus is mounted on a base and protected by a box. In Fig. 2, t_1 and t_2, are the terminals connected to the telephonic apparatus, and those to the line, L_1 and L_2. M. Cailho has also experimented with coils having between 5 and 20 ohms, and even with some as low as 1 ohm, in order to show the possibility of telephoning even with very small resistance in shunt to the circuit, provided the self-induction of the shunts is very high. We may add, for the benefit of those of our readers who may want to try the Cailho system without making special coils, that they can, if need be, be replaced by Morse relay magnets having a resistance of five or six hundred ohms. The wire coming from the telegraph end, PT.

Fig. 2, is then connected to the junction of the two coils of the magnet.

The Cailho system is now in quite extensive use in France; thus it is employed on two circuits between Paris and London, and the lines connecting Paris with Nancy, Lavallois-Perret, Santes (Bordeaux), Limoges, Chartres, Vichy, as well as on other lines radiating from Rouen, Marseilles, Lille, Dijon, Cette, etc.

POWER TRANSMISSION.

VOLTS VS. OHMS.—SPEED REGULATION OF ELECTRIC MOTORS.[1]

BY H. WARD LEONARD.

THE object of this paper is to endeavor to show the advantages arising from the use of a system of motor control having several modifications, but all of which involve the idea of controlling the speed of an electric motor by controlling the e. m. f. generated in its armature circuit and without using any regulating resistances in that circuit.

Fig. 1 shows the first and simplest form of the e. m. f. system of motor speed control. S is an engine or other source of power operating at a practically constant speed. G is a generator. M is the motor. E is a circuit of constant e. m. f. which supplies current for exciting the fields of G and M.

It will be noticed that the fields of both G and M are independent of the e. m. f. and current of their armatures. The field of M is practically constant. The field of G is variable from full strength to zero strength by manipulation of the controlling rheostat C in the field circuit of G. It will also be noticed that there is no rheostat in either the field or armature circuit of the motor, M, which is to be controlled.

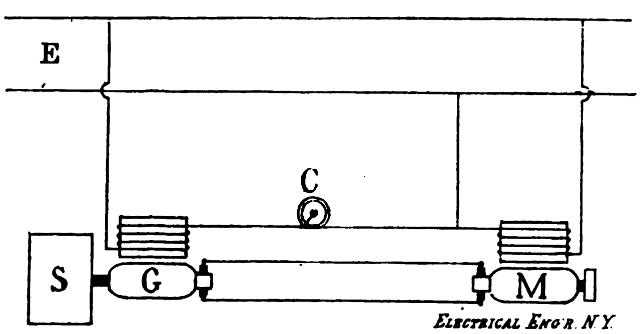


FIG. 1.—LEONARD METHOD OF MOTOR REGULATION.

It will be veident that by varying the field strength of G we can vary the e. m. f. generated in the armature circuit from zero to the full working e. m. f.

The author then showed that when operating the motor at one-tenth of its full speed of 500 revolutions per minute and while under full torque we can throw off the entire load and experience a change in the speed of only 9 revolutions per minute.

He also showed that with rheostat, ohmic resistance control, by the throwing off of the full load, the motor jumps from 41 revolutions per minute to 456 revolutions per minute, a change of 415 revolutions in this case as compared with 9 revolutions in the former case, the change in speed under the same conditions being nearly fifty times as great by the system of ohmic control as by the system of e. m. f. control.

He called attention to the fact that in the speed control by ohms the operator can, by moving the lever of his rheostat, change the volts upon M as fast as he can move his hand. This is a frequent cause of burning out of armatures.

When, however, the change in e. m. f. at the motor is due, as in the case of Fig. 1, to a change of field magnetism, the instantaneous throwing of the lever of the controller does not result in an instantaneous change of e. m. f. at M; for a change of current through G's field results in a gradual although sufficiently rapid change of e. m. f. at G's brushes, and hence the armature of M has a chance to accelerate and develop a counter e. m. f., which, in practice, will never be greatly different from that impressed.

A modification of the general system was also discussed, in which the source of e. m. f. is composed of several different generators in series with each other and having a system of several conductors, upon each of which a different constant potential is maintained, so that by connecting the motor armature across different conductors, different e. m. f.'s are obtainable at the motor armature. With two generators and three conductors three reversible, different automatic speeds can be obtained. Similarly with three generators and four conductors we can get six reversible, different automatic speeds. This modification of the system is especially suited to the distribution of power in an isolated plant such as a large manufacturing establishment.

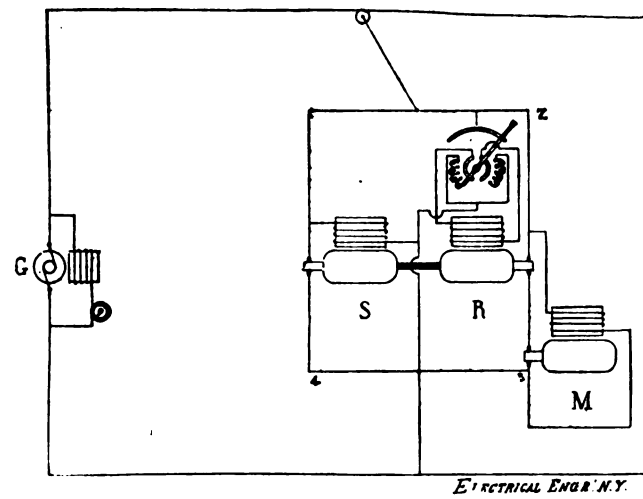


FIG. 2.—LEONARD METHOD OF MOTOR REGULATION.

The author found, when considering the case of the rheostat control with the motor running at 1 ÷ 10 speed and with 100 amperes through it, that the rheostat had to absorb and dissipate 100 amperes × 220.5 = 22,050 watts, while only 2,450 watts were utilized in the motor. This loss in the rheostat is troublesome, not only because of the waste of energy, but especially because of its interference with all positive control. Evidently what is needed is to substitute for the rheostat a device which will absorb the 220.5 volts and 100 amperes, and, instead of wasting them, convert them into useful work.

Fig. 2 shows how this is accomplished by one modification of the e. m. f. system of motor speed control. G is a source of 125 volts constant e. m. f. S is a shunt-wound dynamo connected across the constant e. m. f. and hence running at a constant speed. R is a dynamo mechanically connected to drive or be driven by S, and running at a practically constant speed. The field of R is excited by the main line e. m. f. and is independent of the e. m. f. of its armature and of the current through its armature. It has a variable and reversible field rheostat in circuit by means of which the magnetism of the field of R may be varied and reversed at will. M is the working motor. Its armature is in series with the armature of R across the line. Its field is excited by the main line e. m. f., and hence is independent of the e. m. f. or current of the armature, M.

The author described the action of the combination when a speed variation and reversal is desired.

By weakening of the field of R, we finally have a field of no strength, and hence R becomes inert and we have the full line e. m. f. of 125 volts upon the 250 volt motor, M, which, consequently, runs at half-speed. Under these conditions no energy is transformed by the rotary transformer, RS. If, now, we reverse the connections leading current to the field of R, and send a gradually increasing current around its field, its voltage is added to that of the line instead of being counter as heretofore, until finally its full voltage of 125 being added in series with the line e. m. f. of 125 volts we have upon M 250 volts, and it runs at its full speed. While R is thus adding to the line volts it of course is acting as a generator instead of a motor, which it formerly was, and is now driven by S which acts as a motor instead of a generator. The author called attention to the fact that the current capacity of all three armatures, R, S, and M, is equal, but the full e. m. f. of R and S is only half that of M, which means that the k. w. capacity of R and S is each only half that of M.

The author added a list of installations, in which his system is applied, including elevators, hoists, cloth printing presses, turrets, etc.

THE ILLINOIS INSULATED WIRE COMPANY, Sycamore, Ill., is to erect a $115,000 plant for the manufacture of insulated wire.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, Nov. 18, 1896.

THE NEW PLANT OF THE NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING CO.

BY ORRIN E. DUNLAP.

THE new electric power plant built by the Niagara Falls Hydraulic Power & Manufacturing Company at the water's edge in the gorge at Niagara has been completed and the machines are in operation. This plant was erected for the purpose of supplying the new aluminum factory of the Pittsburg Reduction Company with power, as well as for generating power to be used for other purposes. The power house is a stone structure 100 feet wide and 60 feet long, and the plans of the company contemplate its extension until it shall be 180 feet in length, work on this extension now being under way. In height the power house is one story, the roof being supported by an iron truss, thus leaving the floor free of all posts. In this power house four wheels made by James Leffel & Company, of Springfield, Ohio, and eight electric generators have been installed. Six of these generators were made by the Westinghouse Electric Manufacturing Company, and two of them by the General Electric Company. A traveling hand crane reaches all parts of the floor, and was a valuable aid in setting the machinery. This crane was made by the Structural Steel Works, of Buffalo. The four water wheels stand on the floor, and receive their supply of water through five-foot inlet pipes connected with the penstock. Each wheel has its individual inlet pipe and water supply, and each and every one of them can therefore be operated alone. In the inlet pipes there are 60-inch valves operated by hydraulic pressure. These valves were made by R. D. Wood & Co., after plans drawn by Wallace C. Johnson, M. Am. Soc. C. E., chief engineer of the Niagara Falls Hydraulic Power & Manufacturing Company. Mr. A. F. Sparks, engineer of the James Leffel Company, designed the wheels, and they are models of beauty. Each wheel weighs about fifty tons, and they are supported on double steel beams resting on solid stone foundations. James Leffel & Co. call this wheel their Niagara type. It is a double discharge turbine and consists of a large, flattened, vertical, circular casing containing the guide case of the wheel proper. Through the supply pipes below the water is let into this exterior casing, flowing upwards and surrounding the guide case. A series of oscillating guides, which constitute the gates, admit the water to the runner. The discharge pipes project from the sides of this casing, laterally and down by a gradual curve, to draft tubes 20 feet in length, thus utilizing a portion of the atmospheric pressure. The heads of the large casing are made of 3½-inch cast iron and are of curved form and shape. The straight or cylindrical part of the case is made of steel plates ¾ of an inch thick, double riveted to the cast heads. Within this casing and the guide casing the runner or wheel proper is located on a horizontal shaft, which is supported by adjustable ball and socket oil bearings on heavy arched bridge trees exterior to the outer casing. The runner is made of bronze and iron, and is 74 inches in diameter. The buckets are made of bronze, and receive the water by a sharp dividing ridge, the central portion, upon which the shell is fastened, being of iron. The water is discharged from the wheels laterally into the discharge pipes, and owing to the design of the wheels there is no uncompensated pressure on any part of the wheel, and no end thrust or pressure on the shaft, the whole being in perfect balance wherever it touches water. The head under which these wheels operate is about 210 feet, the highest at Niagara. The gates are made of the best steel, and are of the James Leffel pattern. They are operated by a patent double ring arrangement which places them easily within the control of a hand wheel operated by one person. The governors in use are made by the Lombard Water Wheel Governor Company, of Boston.

The six generators installed for the Pittsburg Reduction Company by the Westinghouse Electric & Manufacturing Company are all alike, each being of 560 kilowatts capacity, designed to generate 2,000 amperes at 280 volts, while operating at 250 revolutions per minute. They were installed under the supervision of Mr. W. K. Dunlap, the Niagara Falls representative of the Westinghouse Company, and are directly connected by flexible couplings to the shafts of the three James Leffel turbines which operate them. The field of each of these machines consists of eight laminated steel pole pieces cast into a circular yoke or frame. Punched steel discs of carefully annealed steel compose the armature core, which is built upon an iron spider, which also carries the commutator. The periphery of the armature is slotted to receive the winding, which is composed of copper bars held in slots by retaining wedges of hard fibre. Should it become necessary to remove an armature coil, these wedges can be taken out very easily, as they are driven into the notches near the top of the slot, longitudinally with the armature. There is a constant circulation of air through the spider and armature core while the machines are running, as ventilating spaces are provided. Carbon brushes are used, the brush holders being supported by a casting secured to the bearing. The commutators are made of rolled copper, the segments being spaced by prepared mica.

Mr. I. R. Edmands, who represents the General Electric Company at the Falls, installed the two generators built by his company for this plant. They are firmly connected to the water wheel and make 300 revolutions per minute. The General Electric Company's generators are each of 750 horsepower, and give 1,000 amperes at 550 volts. They are com-

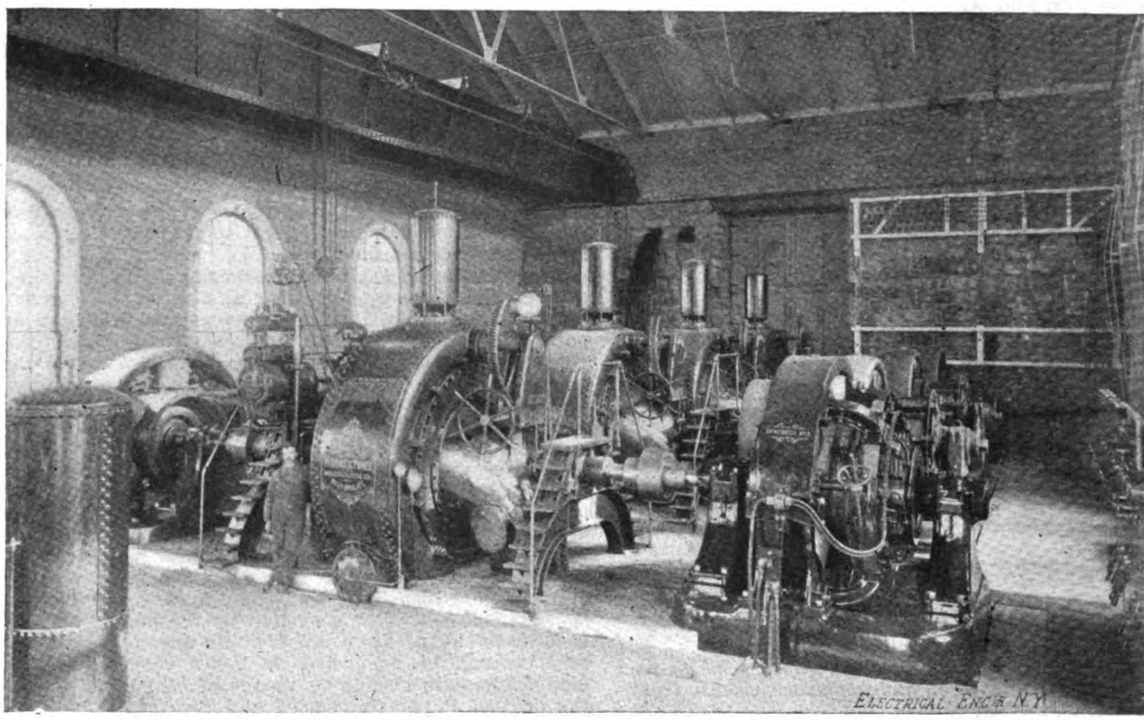


FIG. 1.—INTERIOR OF NEW POWER HOUSE, NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING CO.

pound wound for railway service, and are to be run in multiple. The Niagara Falls Hydraulic Power and Manufacturing Company now supply the Niagara Falls and Lewiston Railroad and the Lewiston and Youngstown road with electric power, and for this service another generator of General Electric make is used as a "booster," standing on the power house floor, not far from the generators; it is most serviceable. In addition to this some of the current from these generators is used about the city. The switchboard for the General Electric Company's apparatus is made of Vermont marble, Weston ammeters and standard General Electric circuit breakers being used.

The water supply of this plant comes from the upper Niagara River, and flows through a canal 4,400 feet long, 70 feet wide

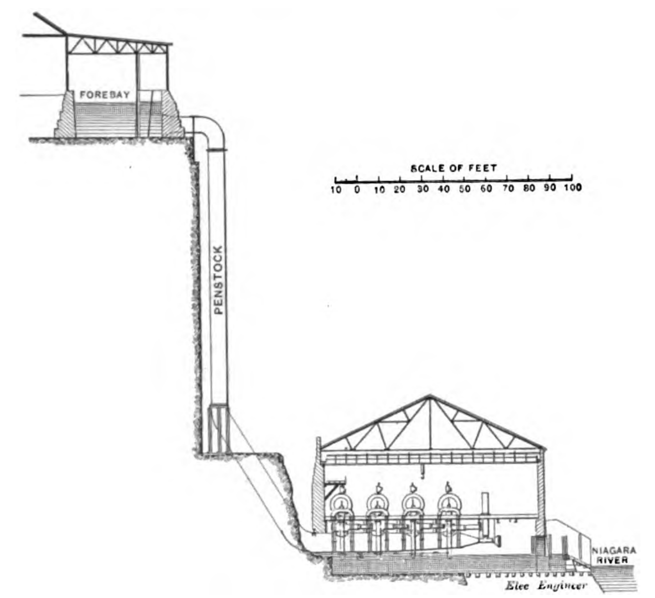


FIG. 2.—NEW POWER HOUSE OF NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING CO. SECTIONAL VIEW.

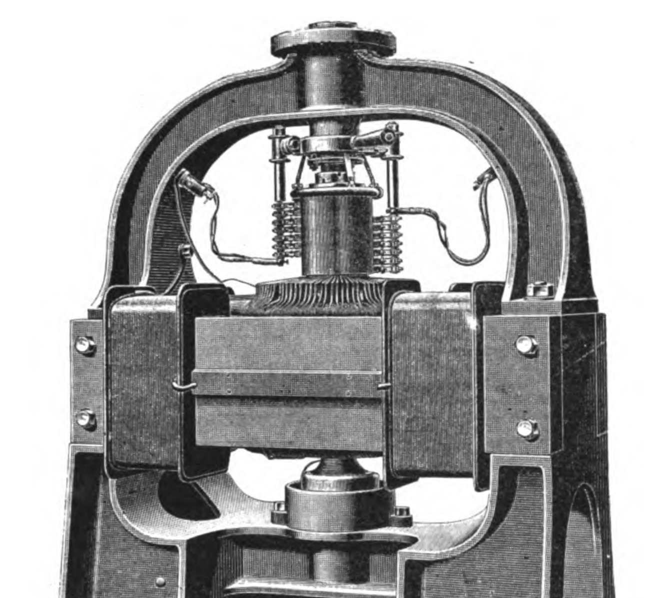
and 11 feet deep, to a basin 400 feet long and 70 feet wide. which runs parallel to the high bank. Preparatory to the construction of this power plant another canal 275 feet long, 16 feet wide and 20 feet deep, was constructed to carry water from the basin referred to to a forebay 180 feet long, 30 feet wide and 22 feet deep, built at the edge of the high bank. The south end of this forebay is closed by a wooden dam, the idea being to extend the forebay at some future time when another connection will be made between it and the canal basin. The gate house stands over this forebay, and here are the gates by which water is let into the penstock, after having passed through screens to remove floating substances. The apparatus for handling these gates is the pride of Engineer Johnson, for it was designed by him. In front of each pair of gates stand two cast iron cylinders containing a piston, and about eight feet high. A pump operated by an electric motor is connected to the tops and bottoms of these cylinders, and by this means oil can be forced into the top or bottom of the cylinders as desired. The piston rods of the two cylinders are connected at the top by an iron beam carrying four heavy iron hoops, and these hoops take hold of pins in the gates. By running the pump and adjusting the valves, the gates may be raised or lowered, opened or closed, and one or both gates may be handled at a time. Beneath the gate house there is also a waste gate, built for the purpose of cleaning the canal. This gate consists of two gates, each eight feet wide and twenty feet in length. In length the gate house is 180 feet and its width is 46 feet. It is an iron frame structure covered with corrugated iron. The penstock that carries the water supply to the wheels is eight feet in diameter and made of the best quality steel plate. In leaving the forebay it runs in a horizontal direction for about 25 feet to clear the edge of the bank, and then it extends in a vertical direction 125 feet to a solid foundation on the lower Niagara limestone. It then runs at an angle of 45 degrees to the power house building, extending under the floor about 70 feet, for which distance it is 10 feet in diameter. At the top the steel plate of the penstock is 5-16 of an inch thick, and at the bottom it is 15-16 inches in thickness. In passing beneath the power house floor the penstock runs through the tail race, in which it hangs suspended by 48 iron rods, each 1½ inches square, supporting a weight of at least 300,000 tons. The pressure on the lower portion of this penstock is 100 pounds to the square inch. The tail race is formed by two masonry walls standing 17½ feet apart and extending from a point six feet below the water in the river back to a point 20 feet above or to the power house floor.

The current from the generators of the Pittsburg Reduction Company flows into copper bus bars from which it is conducted by 500 aluminum wires forming two cables up to the top of the bank to the pots of the new aluminum plant. This building is of iron and of good sized dimensions, its capacity being about 5,000 pounds per day. Mr. W. S. Ferguson is the superintendent. This factory is a very substantial addition to the possessions of the Pittsburg Reduction Company, at Niagara Falls, and is destined to add materially to the world's output of aluminum. The company now distinguish their Niagara plants by calling them the Upper and Lower works.

The superintendent of the new power plant is Mr. F. G. Lott, who also has charge of the plant of the Buffalo Electric Light and Power Company. Mr. Lott has had charge of the electric part of the work on behalf of the power company. The formal opening of the plant took place on Monday, Nov. 23, when many prominent citizens of Buffalo and Niagara Falls visited the power house by invitation of Mr. Arthur Schoellkopf, the local head of the company, and admired the installation, which is beyond doubt the greatest improvement the company have made to their power property since they bought it in 1877. The years which have passed since the organization of the Niagara Falls Hydraulic Power and Manufacturing Company have been busy ones for them, for they have expended many thousands of dollars in the enlargement of their waterway and the development of its energy. The new plant is of unusual importance because it outlines and defines the success of a valuable method of developing Niagara's force.

MOTOR FOR DRIVING CENTRIFUGAL PUMP.

We illustrate on this page one of a set of eight electric motors constructed by Messrs. Ernest Scott & Mountain, Limited, of the Close Works, Newcastle-on-Tyne, for driving the centrifugal pumps used for clearing water from a large floating dock . As will be seen the armature axis is placed vertically, being fitted with a coupling below to bolt on to another flange on the pump spindle. The field magnets are



MOTOR FOR DRIVING CENTRIFUGAL PUMP.

bolted to a heavy cast-iron standard which also supports the bearings of the armature spindle. The commutator is located on the upper portion of the machine, being therefore easily accessible. The motors are designed to run at 350 revolutions per minute, at which they develop 60 effective horse-power. We are indebted to London "Engineering" for the accompanying illustration.

THERMO-ELECTRICITY.

THE ACTION IN THE JACQUES CARBON CELL.

BY C. J. REED.

I HAVE read with great interest the article in The Electrical Engineer of Nov. 25, on the "Jacques Carbon Generator." I believe that, accepting the data now published by Dr. Jacques, there can be no further discussion as to the efficiency of the battery devised by Dr. Jacques. Its commercial utility will depend entirely upon his success in dealing with the "many details to be worked out and many improvements yet to be made, before the carbon electric generator can be put into commercial use on a scale comparable with that of modern steam engines." The results now given by Dr. Jacques are certainly most gratifying and encouraging, if we consider only the question of weight of material consumed; and it is to be hoped that Dr. Jacques will succeed as well in overcoming the other practical difficulties, such as the expense of getting the carbon into a suitable form, of maintaining the electrolyte in its proper condition and of protecting the apparatus from destruction.

As to the nature of the reaction that takes place within the cell and the origin of the electromotive force—whether it be galvanic or thermo-electric—the additional data furnished by Dr. Jacques gives us little, if any, assistance in arriving at a conclusion.

The fact that carbon dioxide is formed and that oxygen and carbon are consumed and that the theoretical current and voltage are obtained is no indication that the action is not thermo-electric, but rather an indication that it is thermo-electric. If the current obtained corresponds exactly to the electro-chemical equivalent of the carbon consumed and the carbon dioxide produced (which seems to be the case in the Jacques cell), there seems to be but one answer to the question, viz., that the action is thermo-electric and that the oxidation of the carbon is due to the electrolytic action of the thermo-electric current. In that case the energy of the carbon would be consumed in maintaining the electromotive force on closed circuit, provided no hydrogen or metal were allowed to pass out of the electrolyte; that is, provided there is no reduction of hydrogen or metal to the metallic or other insoluble state. If hydrogen or any other metal passes by reduction out of solution in the electrolyte, the energy of the carbon will first supply that absorbed by the reduction, and if a balance remains, that balance will go towards maintaining the electromotive force on closed circuit. Such a reaction should be very economical, but could not take place with evolution of energy in an electrolyte consisting of pure caustic alkali, since the reduction of either hydrogen or the alkali metal (the only reducible constituents) would require the absorption of more energy than that contained in the carbon.

If the carbon dioxide produced is in excess of the electro-chemical equivalent of the current, there must be oxidation independent of any thermo-electric current, that is, spontaneous oxidation. Such action could be galvanic only where the oxygen is derived from the decomposition of the electrolyte, as, for instance, from the reduction of hydrogen or a metal. In the Jacques cell this could not occur if the electrolyte were pure caustic alkali, for the reason that the carbon could reduce the hydrogen or alkali metal only by the absorption of energy, not by its evolution.

If the action in the Jacques cell is galvanic, that is, if the chemical action is spontaneous and not a result of electrolysis, the chemical action will continue to take place on the carbon after it has passed out of the electric circuit. Therefore particles of carbon that necessarily become detached by the mechanical disintegration of the electrode will continue to be consumed and to evolve carbon dioxide. The quantity of carbon consumed and of dioxide formed will, therefore, necessarily be greater than that corresponding to the electrical energy evolved.

If, on the other hand, the action of the cell is thermo-electric and the chemical action a result of electrolysis, no carbon can oxidize after it has passed out of the electric circuit, and the detached particles could undergo no oxidation. The quantity of carbon consumed and of dioxide produced would in that case be the exact equivalent of the current, as in other electrolytic reactions. That the action is thermo-electric appears to be established by results obtained by Dr. Jacques. He says:

"Later experiments with far larger apparatus have not only confirmed these results, but have shown that under proper conditions the electrical energy obtainable from one of these generators is substantially equal to the potential energy of the weight of carbon consumed in the pot."

The only theory of the action of the Jacques cell, which seems to satisfactorily account for all the facts that have been observed, is that suggested by Prof. Elihu Thomson[1]. This theory is in substance that the electrolyte, instead of being pure caustic alkali, contains oxide of iron, or in other words, is a fused alkaline ferrate. This electrolyte supplies oxygen by reduction of the iron (either to the metallic state or to a lower oxide), and is regenerated by the atmospheric oxygen, which reoxidizes to alkaline ferrate the reduced iron. This electrolyte satisfies either the thermo-electric or the galvanic theory; but the quantitative results obtained by Dr. Jacques, as quoted above, appear to exclude the galvanic, and limit us to the thermo-electric theory. I would suggest that the validity of the theory may be tested by substituting a silver crucible for the iron pot of the Jacques cell and using caustic alkali free from iron and other impurities and a silver tube for the introduction of air. With such an apparatus I venture the prediction that no electrical energy will be obtained from the consumption of "carbon within the pot."

Whatever theory finally proves to be correct as to the nature of the action in this cell, it cannot, of course, in any way detract from nor add to the value of Dr. Jacques' discovery, if he succeeds in obtaining a commercial efficiency of 32 per cent.

SOCIETY AND CLUB NOTES.

NATIONAL CONFERENCE ON ELECTRICAL RULES.

AT the joint conference of electrical, insurance and allied interests looking toward the adoption, promulgation and enforcement of a national code of rules for electrical construction and operation, which was held March 18 and 19 of this year at the headquarters of the Am. Soc. of Mechanical Engineers, this city, a large amount of work was done; and after a permanent organization to be known as the "National Conference on Standard Electrical Rules," had been effected with headquarters at 12 West Thirty-first street, New York, it was decided to place the work of drafting the final code in the hands of a committee of eight, including the president (ex-officio), who were to report back to the next meeting of the National Conference. This committee consisted of the following gentlemen: Prof. Francis B. Crocker, chairman, delegate Am. Ins. of Elec. Engineers; Frank R. Ford, secretary, delegate Am. St. R. R. Association; William Brophy, delegate National Elec. Lt. Association; William H. Merrill, Jr., delegate National Board of Fire Underwriters; E. A. Fitzgerald, delegate Underwriters Nat. Elec. Association; Alfred Stone, delegate Am. Ins. of Architects; E. V. French, delegate Am. Factory Mutual Ins. Cos.; W. J. Hammer, ex-officio.

This committee have recently met in New York and spent two days upon the preparation of the code and then adjourned to meet again Dec. 11 and 12, this date being decided upon in order to enable the Underwriters' National Electric Association, which meets in this city Dec. 8 and 9, to consider the suggestions already made by the code committee, to secure their criticisms and co-operation in the matter. It is expected that shortly after the next meeting of the code committee, the National Electrical conference will be called to take action upon the code prepared by the committee.

It is gratifying to observe that the various engineering societies and the strong representation of the insurance organization, represented in the National Electrical Conference, are working so harmoniously and with so much energy to bring about the single national code of rules.

ELECTRICITY AND THE HUMAN BODY.

Before the Department of Electricity of the Brooklyn Institute., on Friday, Dec. 4, at the Art Building, Dr. W. M. Hutchinson will lecture on "Electricity in its relation to the human body." The lecture will be illustrated by lantern photographs and experimental demonstrations.

ANNUAL MEETING CONNECTICUT STREET RAILWAY ASSOCIATION.

The annual meeting of the Connecticut Street Railway Association was held at New Haven on Nov. 18. Rrepresentatives were present from all the New Haven, Hartford, Bridgeport, Waterbury, New Britain, Derby, Bristol and Norwalk lines and from the Westport and Saugatuck road. The election of officers resulted as follows: President, H. Holton Wood, Der-

[1] Jour. Franklin Institute, Nov., 1896.

by; vice-president, Henry S. Parmelee, New Haven; secretary, E. S. Breed, New Britain; treasurer, E. S. Goodrich, Hartford; executive committee, A. M. Young, of Waterbury; Israel Kelsey, of West Haven, and G. W. Dodge, of this city.

A general discussion followed on matters of interest to street railway officials. The delegates inspected the street railway lines of the city and at 2:30 o'clock the annual banquet was held in the New Haven House.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Central Stations:

ELECTRICITY WORKS AT JEVER, OLDENBURG.—A small municipal plant. It is described in detail, but is simply a typical small German station with its accumulators.—"Elektrot. Zeitschr.," Oct. 8, '96.

ELECTRICITY WORKS, ZURICH.—Abstract of the annual report for '95, of the works. The increase of lamps, motors, and other apparatus amounts to 60 per cent. for one year.—"Elek. Zeit.," Oct. 22, '96.

THE DOUGLAS SOUTHERN ELECTRIC TRAMWAY.—In one of the finest sections of the Isle of Man, the trolley system is being gradually developed. The plant is not a very large one, two 100 kilowatt generators supplying the power. Details in Lond. "Lightning," Oct. 29, '96.

BURY ELECTRICAL WORKS.—A municipal undertaking. Details of plans are described and illustrated. The three-wire low tension system was adopted. Accumulators are used in connection with the system.—Lond. "Elec. Eng'r.," Nov. 6, '96.

Dynamos and Motors:

OERLIKON THREE-PHASE ASYNCHRONOUS MOTORS.—A general description of the principal standard types manufactured by this company.—Lond. "Elecn.," Oct. 30, '96.

Educational;

LECTURES ON ELECTRICAL ENGINEERING IN THE GERMAN TECHNICAL HIGH SCHOOLS DURING THE WINTER TERM, '96 & 97.—The schools in Berlin, Braunschweig, Darmstadt, Dresden, Hanover, Karlsruhe, Munich and Stuttgart are mentioned, with the names of the instructors, their subjects and the number of hours per week.—"Elek. Zeit.," Oct. 8, '96.

Electro-Physics:

COMPLETE APPARATUS FOR THE STUDY OF THE PROPERTIES OF ELECTRIC WAVES.—By J. Chunder Bose, M. A., D. Sc. Read before the Brit. Assoc., Section A. Author exhibited instruments with which he was able to obtain the values of the indices of refraction of various substances for electric waves, the wave length of electric radiation, and to demonstrate the phenomena of double refraction and polarization of the electric ray. The complete apparatus consists of: (1) A radiating apparatus emitting electric waves of short lengths; (2) a receiver used as a detector of electric radiations; (3) various accessories for the study of the different phenomena. These are described in detail in the Lon. "Elecn.," Oct. 16, '96.

Lighting:

THE LOCALIZATION OF FAULTS IN ELECTRIC LIGHT MAINS.—By F. C. Raphael. Continuing previous articles, author devotes this section to the finding of faults on series arc lamp circuits by the potential and loop methods, and commences a section on fault signaling networks.—Lond. "Elecn.," Oct. 16, '96.

Measurements:

MEASUREMENTS OF EARTH RESISTANCE OF HIGH TENSION CURRENT BY MEANS OF THE LINE VOLTAGE.—By Dr. Oscar May. Author explains the use of the voltmeter and milliamperemeter in this connection.—"Elek. Zeit.," Oct. 22, '96.

EFFECT OF INSULATION RESISTANCE AND CAPACITY ON THE ABSOLUTE POTENTIALS IN ALTERNATE CURRENT SYSTEMS.—By A. von Ettinghausen and G. Ossana. Authors give the results and their methods of procedure in testing several three-phase power plants.—From the "Zeit. f. Elek.," in Lond. "Elec.," Oct. 30, '96.

ON THE PROTECTION OF THE MIRROR GALVANOMETER AGAINST DISTURBANCES OF EARTH CURRENTS.—By Dr. Classen. A simple device will accomplish the required result. Two small iron wire bunches are brought close to the astatic needles and are arranged so that they can be easily raised or lowered and thus counterbalance the varying earth current.—"Elektrot. Zeitschr.," Oct. 29, '96.

Miscellaneous:

KINETOSCOPE STEREOPTICON.—Popular explanation of this new fad, embracing under one general heading all the various types, such as vitascope, cinematograph, etc.—"Scient. Am.," Oct. 31, '96.

VEERING DRUMS FOR LIGHTSHIPS.—Capt. H. Benest has devised a form of veering drum in connection with the problem of telegraphic communication with lightships. The object in view, is to provide lightships, which are fitted with an electric cable, with means for automatically securing the normal condition of twist in the electrical cable, while the vessel swings around under the action of the shifting tide or wind. For a clear understanding of this subject see the illustrated description in Lond. "Elec. Rev.," Oct. 30, '96.

Power Transmission:

GENEVA ELECTRICAL WORKS.—Special turbines had to be designed to take care of the wide ranges of water flow between summer and winter. The regulator will with a very small angular motion entirely cut off the water. The top of the main shaft supports a cast iron bell, which takes the place of the field magnets of the alternator. This enormous weight is lifted by oil under pressure to reduce friction. The transmission line of 4½ miles is entirely underground.—Lond. "Elec.," Oct. 30, '96, "Elec. Engr.," Dec. 2, '96.

COST OF CURRENT TO THE CONSUMER.—An editorial explains a new method of charging for current, introduced by the Electricity Works of Upper Silesia, and one which seems to meet with general approval. Up to a certain number of kilowatt hours, a certain price per k. w. hr. is charged; everything above that is furnished for smaller sums.—"Elek. Zeit.," Oct. 1, '96.

SWITZERLAND FOR THE YEARS 1894 AND 1895.—By Dr. Denzler. The summary of the statistics is as follows:

	1895.	1893.	1889.
Lighting installations	866	677	351
Transmission plants	121	77	25
Accumulator batteries	248	161	41
Dynamos and motors	2,553	1,404	536
Total capacity in kilowatt	58,485	28,831	7,060
Incandescent lamps	212,568	145,984	51,155
Arc lamps	2,714	2,126	845

—"Elek. Zeits..," Oct. 1, '96.

GERMAN ELEVATOR SERVICE.—By G. Speiser. Author illustrates and explains the automatic starting and stopping devices of the E. A. G.'s elevator motors for freight and passenger service.—"Elek. Zeit.," Oct. 15, '96.

THE FIRE RISK IN BELT TRANSMISSION OF POWER.—By Wm. Elmer, Jr. The writer points out how many fires occur from some unknown cause and the blame is laid to poor wiring, whereas in many cases it may be shown that it was really caused by a hot journal or by the belting rubbing gainst some inflammable material.—"Elec. World," Nov., "Am. Gas Light Journ.," Nov. 16, '96.

A LONG-DISTANCE POWER TRANSMISSION SCHEME.—Keewatin Power Co., intend to transmit power from Keewatin to Winnepeg, a distance of 120 miles, using from 25,000 to 30,000 volts. They are now preparing specifications.—Editorially mentioned in "Can. Elect. News.," Nov., '96.

TRANSMISSION PLANT EICHDORF-GRUNBERG.—By Walter Klug. A 10,000-volt three-phase transmission plant with many points of special interest. Current is generated at 250 volts and transformed there to 10,000. Triple petticoat insulators are used and a special type of lightning arrester is introduced. For details of plant as well as diagrams and plans, see "Elektrot. Zeitschr.," Nov. 5, '96.

Railways:

A RAILWAY POWER HOUSE TRANSFORMED.—The plant of the Cicero and Proviso Street Railway Company in the Western suburbs of Chicago has undergone such changes during the last five years that it stands to-day as one of the most modern plants. For details see "West. Elec.," Nov. 14,'96.

Roentgen Rays:

NOTE ON A CATHODE RAY SPECTRUM.—By M. Birkeland. The principal observations of the author are: 1, When the primary current is continuously increased, the magnetic deflection of all the bands diminishes, so that they draw nearer to one another; 2, when the pressure in the tubes is

diminished, the primary current remaining constant, the magnetic deflection of the cathode rays also diminishes continuously, first quickly, then slowly, as if toward a limit.—From "Comptes Rendus," No. 13 in Lond. "Elec.," Oct. 16, '96.

THE NATURE OF THE ROENTGEN RAY.—Sandrucci, an Italian physicist, has made a series of experiments to determine whether the rays act directly on the photographic film or indirectly, by producing phosphorescence in the glass in contact with the film. Results show the first to be the case.—Lond. "Elec. Rev.," Oct. 30, '96.

DISTRIBUTION OF ELECTRICITY ON THE SURFACE OF CROOKES AND GEISSLER TUBES.—Villari, an Italian scientist, sifts over the surface of a tube a mixture of powdered sulphur and red lead; the latter will adhere to the negatively charged, the sulphur to the positively charged surface. It is found that the center of the tube is covered with the lead in irregular figures, while the rest of the tube distributes the sulphur uniformly over the surface. A neutral space separates the sulphur from the red lead.—Lond. "Elec. Rev.," Oct. 30, '96.

Wires, Wiring, Etc.:

DISSIPATION SHEETS AND WIRES.—This article points out the difficulty of close calculation on account of the many experimental coefficients required. It gives, however, some general points for calculating the size for dissipation sheets, dissipation wires and a general résumé of some practical dissipators.—Lond. "Elecn.," Oct. 30, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 17, 1896.

Alarms and Signals:—

ELECTRIC SIGNAL BOX. W. W. Hibbard, Rochester, N. Y., 561,441. Filed June 16, 1894.
Comprises two signal boxes set one within the other and separated by a clear space, four spiral springs at the corners connecting the boxes and sustaining the interior one, and insulators around which the springs rest.

ANNUNCIATOR. F. A. Jennings, Ithaca, N. Y., 571,445. Filed May 11, 1895.
Designed to be used to indicate the time status of railway trains.

TRACK INSTRUMENT. T. B. Dixon, Henderson, Ky., 571,472. Filed Nov. 15, 1895.
Means for counteracting the effect of residual magnetism in the magnetic conductors. For railroad signaling.

ELECTRIC SIGNALING SYSTEM. J. P. Buchanan, Boston, Mass., 571,507. Filed Feb. 5, 1894.
Comprises a signal falling by gravity into "danger" position, and an electromagnet arranged to operate the signal to put it to "safety."

Batteries, Primary:—

PRIMARY BATTERY. S. N. Smith, Minneapolis, Minn., 571,460. Filed Nov. 16, 1895.
Details of construction.

Batteries, Secondary:—

MANUFACTURE OF PLATES FOR ELECTRIC ACCUMULATORS. J. Kerner, Mannheim, Germany, 571,598. Filed Jan. 6, 1896.
A protective layer of sulfate of potash is deposited on the plate, and then the active material or paste is applied.

Conductors, Conduits and Insulators:—

ELECTRICAL SWITCH CONDUCTOR. W. H. Sawyer, Providence, R. I., 571,539. Filed Aug. 12, 1896.
An electrical conductor composed of an elastic rubber core, surrounded by a braided web carrying one or more wires and the whole inclosed within a suitable wound covering. Intended for telephone switchboard cords.

CABLE TERMINAL BOX. W. H. Johnston, St. Louis, Mo., 571,504. Filed Sept. 14, 1896.
An arrangement whereby the conductors of one cable may be brought without intermediate wiring into connection with another cable, each cable being protected by a distinct cable head.

ELECTRIC CABLE. S. P. Thompson, London, England, 571,706. Filed July 20, 1892.
Comprises two or more insulated conductors running therethrough side by side and provided at intervals with compensating devices for diminishing the electrostatic capacity.

ELECTRIC CABLE. S. P. Thompson, London, England, 571,707. Filed July 20, 1892.
Consists in dividing the circuit into a series of successive separately insulated metallic return circuits, in each of which a movement of electricity takes place, and in connecting these circuits by mutual induction.

Dynamos and Motors:—

COMMUTATOR BRUSH. A. K. Warren, New Brighton, N. Y., 571,420. Filed May 15, 1896.
Consists of material adapted to rub on a commutator ,an extension piece of similar cross-section to the brush, and means for fastening the brush and extension together.

ALTERNATING CURRENT MOTOR. M. Hutin and M. Leblanc, Paris, France, 571,478. Filed May 25, 1895.
Comprises an electric circuit possessing self-induction, charged with alternating currents, an electrolytic polarization battery having a sufficient number of cells in series to neutralize by polarization the electromotive force of the self-induction in the circuit.

Electro-Metallurgy:—

MAGNETIC SEPARATOR. J. B. Hamilton, Springfield, Mass., 571,362. Filed Dec. 5, 1893.
Designed for the extraction of iron particles from pulp in the manufacture of paper.

PROCESS OF PRODUCING COATINGS COMPOSED OF EARTHY OXIDS, 571,532. Filed Nov. 29, 1895.
Consists in electrolyzing a dilute aqueous solution of metahydroxid of an alkali earth metal by an electric current of low density depositing thereby upon an electroconductive foundation a coating of hydroxid and finally drying and calcining the deposit.

ELECTROLYTIC PROCESS OF CONVERTING HYDROXIDS OF EARTH AND EARTH ALKALI METALS INTO INDISSOLUBLE ORGANIC OR INORGANIC SALTS, ETC. R. Langhans, Berlin, Germany, 571,533. Filed March 28, 1896.
Consists in placing a coated foundation as an anode in an electrolyte which consists in an aqueous solution of an acid capable of converting the hydroxid coating into a salt which is indissoluble in the bath, but reducible to oxide by the action of heat and electrolyzing by a current of low density.

PROCESS OF PRODUCING COATINGS COMPOSED OF EARTHY OXIDS. R. Langhans, Berlin, Germany, 571,531. Filed Nov. 18, 1895.
Relates to above process.

ELECTRIC FURNACE. A. C. Girard and E. A. G. Street, Paris, France, 571,655. Filed May 24, 1895.
A fixed carbon through which the material to be heated is fed, the carbon tube constituting a common electrode, and one or more other electrodes arranged in proximity to the carbon tube, whereby the material under treatment is separated from the arc.

APPARATUS FOR ELECTROLYSIS OF CHLORIDS, ETC. J. Hargreaves, Farnsworth-in-Widnes, and T. Bord, Cressington, England, 571,591. Filed Jan. 4, 1894.
A cell having opposing porous diaphragms, and an anode and cathode, respectively, located in contact with the exterior surfaces of the diaphragms.

PROCESS OF TREATING ORES. T. P. Barbour, San Antonio, Tex., 571,468. Filed Nov. 7, 1893.
Consists in first treating the raw material with copper oxid and sulfuric acid, then chlorinating the pulp thus treated, introducing the chlorinated mass into a suitable agitator having zinc therein, and establishing an electric current through the mass in the presence of zinc.

Miscellaneous:

ELECTRIC GAS LIGHTING APPARATUS. C. W. De Mott, Brooklyn, N. Y., 571,723. Filed May 8, 1896.
Details of construction.

ELECTRIC ELEVATOR. R. Wilson, Louisville, Ky., 571,502. Filed July 8, 1895.
The combination of a car, an electric motor, two speed controlling rheostats and a solenoid having two independent cores, respectively, operating rheostats.

ELECTRICALLY OPERATED WATER SUPPLY SYSTEM. J. P. Barrett, Chicago, Ill., 571,328. Filed Aug. 31, 1895.
Employs electrically operated pumps which may be thrown into operation when desired to assist the main pumping apparatus.

ELECTRIC THERMOMETER. M. A. Agelasto, Norfolk, Va., 571,426, Filed May 8, 1896.
The temperature is determined by means of change in resistance of a coil by the aid of a Wheatstone bridge.

COMBINED ELECTRIC HYDRAULIC ELEVATOR. J. Parkinson, Los Angeles, Cal., 571,730. Filed April 10, 1895.

COMBINED ELECTRIC HYDRAULC SCREW-CONTROLLED ELEVATOR ENGINE. J. Parkinson, Los Angeles, Cal., 571,731. Filed June 25, 1895.

COMBINED ELECTRIC HYDRAULIC ELEVATOR. J. Parkinson, Los Angeles, Cal., 571,732. Filed Dec. 3, 1895.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. G. J. Forrey, Carlisle, Pa., 571,435. Filed Feb. 29, 1896.
A third-rail system in which the third rail is energized only as the car passes over it.

CABLE CARRIER. E. L. Heidenreich and G. Monrath, Chicago, Ill., 571,440. Filed Aug. 15, 1896.
The improvements are directed more especially to carriers suspended from a cableway and furnished with an electric motor controlled by the operator on the car for hauling logs.

RAIL SUPPORT. W. B. Potter, Schenectady, N. Y., 571,454. Filed Aug. 25, 1896.
Comprises a body of insulating material, a metallic cap having a fixed lug and a removable lug, the two lugs adapted to engage with the flange of the rail, and means, consisting of a slot through the shank of the lug and a tapered pin passing through the slot, for securing the removable lug in place.

RAIL SUPPORT. W. B. Potter, Schenectady, N. Y., 571,455. Filed Aug. 25, 1896.
Similar to above.

AUTOMATIC TROLLEY SWITCH. L. M. Erb, Leavenworth, Kan., 571,517. Filed Feb. 29, 1896.
Comprises a shiftable tongue and a trigger lying in the path of the tread of the trolley wheel and adapted to be moved upward by the upward pressure of the trolley and thereby shift the tongue.

TROLLEY FOR ELECTRIC CARS. S. F. Tufts, Westbrooke, Me., 571,710. Filed Oct. 9, 1895.
Consists in so mounting the contact wheel that it will have a vertical and a lateral motion.

ELECTRIC BRAKE. E. A. Sperry, Cleveland, O., 571,409. Filed June 20, 1896.
Comprises motors operating as generators to supply a braking current and electromagnetic devices, an auxiliary source of electromotive force independent of the motors and the trolley current, and a device for causing the current from the auxiliary source to pass through the brake magnets when the braking current ceases.

ELECTRIC CONTROLLER. E. A. Sperry, Cleveland, O., 571,410. Filed July 31, 1896.
Comprises a contact cylinder, a limit switch mounted on the core of the magnet, an arm for opening the switch, and a cam actuated by a movement of the controller handle for operating the arm.

Regulation:—

ELECTRIC GOVERNOR FOR WATER WHEELS. W. W. Hanly, Baltimore, Md., 571,363. Filed June 19, 1896.
Intended for use in electric plants run by water power. A solenoid acts as the governing medium.

REGULATING POLYPHASE CIRCUITS. A. H. Armstrong, Schenectady, N. Y., 571,467. Filed May 2, 1896.
Consists in combining with the main electromotive force derived from the generating source another constant electromotive force and then varying the phase relation between the main impressed electromotive force and the constant electromotive force from coincidence of phase to direct opposition.
CONTROLLER FOR ELECTRIC PUMPS. F. W. Merritt, Duluth, Minn., 571,600. Filed Feb. 14, 1896.
Means to maintain the pressure at a certain point by breaking the electric circuit of the pump motor when the pressure rises to a certain limit and closing the circuit when the pressure falls to a certain limit.

Switches, Cut-Outs, Etc.:

CONTROLLING ELECTRIC ARCS. E. Thomson, Swampscott, Mass., 571,463. Filed June 26, 1896.
Employs a compound field for acting upon the arc.
MANUFACTURE OF ELECTRICAL RESISTANCES. A. J. Marquand, Cardiff, and D. Lowden, Barry Rock, England, 571,489. Filed June 25, 1896.
Composed of asbestos cloth having deposited in its texture carbon resulting from the decomposition of carbonaceous material in contact with the asbestos cloth.
LIGHTNING ARRESTER. A. de Khotinsky, Boston, Mass., 571,669. Filed Sept. 24, 1896.
Consists of two carbon plates having their proximate surfaces grooved and a centrally slotted non-conducting septum between them, the edges of the slot coinciding with the axial or central lines of the groove.
ELECTRIC CUT-OUT. B. F. Rout, Stanford, Ky., 571,734. Filed March 27, 1896.
Particularly adapted for use in house circuits.

Telegraphs:—

ELECTROMAGNETIC SIGNAL-RECEIVING INSTRUMENT. S. D. Field, Stockbridge, Mass., 571,351. Filed Aug. 11, 1896.
For use in relays and annunciators.
TELEGRAPH SWITCH MECHANISM. F. P. Scott, Terre Haute, Ind., 571,695 Filed March 25, 1896.
The switching mechanism is operated by an electric motor controlled from a distant station.
COIN, CONTROLLER MECHANISM FOR TELEPHONES. R. D. Gallagher, Jr., Chicago, Ill., 571,590. Filed March 14, 1896.

Telephones:—

TELEPHONE TRANSMITTER. D. N. Rowan, Irvington, N. Y., 571,399. Filed Dec. 10, 1895.
Comprises flexible non-conducting shelves, electrodes, and granular conducting material suspended on the shelves between the electrodes.
MICROPHONE TRANSMITTER. E. A. Barkalow and N. Crawford, Kokomo, Ind., 571,504. Filed July 31, 1896.
Employs a carbon pencil within the microphone box running parallel to the transmitter diaphragm .

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 24, 1896.

Alarms and Signals:—

ELECTROMAGNETIC SENTINEL. F. B. Badt, Chicago, Ill., 571,739. Filed Feb. 15, 1896.
Means for detecting the approach of a mass of magnetic material, such as armor clad warships.
STATION POTENTIAL INDICATOR. R. D. Mershon, Pittsburg, Pa., 571,839. Filed Dec. 23, 1895.
Comprises a local circuit in which the impressed and counter electromotive forces of the main line are approximately reproduced in miniature, and a voltmeter for indicating the value of the resultant electromotive force.
FIRE ALARM SIGNAL BOX. G. F. Milliken, Boston, Mass., 571,950. Filed Dec. 14, 1891.
The circuit is not opened by the signaling wheel until after a lapse of time longer than the longest closed circuit period of any signal.
BINDING POST FOR ELECTRIC BELLS, ETC. F. W. Manger and O. H. Huebel, Brooklyn, N. Y., 571,977. Filed March 24, 1896.
Means whereby the binding post may be attached which will prevent its turning with the clamping nut.
AUTOMATIC TEMPERATURE ANNUNCIATOR. J. A. Young, Indianapolis, Ind., 572,081. Filed May 11, 1896.
Consists of a suitable base upon which is mounted a temperature thermometer and a suitable mechanism, so connected to a system of wires and batteries that an alarm is sounded by means of a gong when a certain degree of temperature is reached.
ANNUNCIATOR. F. A. Jennings, Ithaca, N. Y., 572,057. Filed May 11, 1895.
Designed to indicate the time status of railway trains.

Conductors, Conduits and Insulators:—

MEANS FOR INSULATING ELECTRIC CONDUCTORS. T. Gilleaume, Mulheim-on-the-Rhine, Germany, 571,760. Filed Nov. 2, 1895.
Relates to conductors with paper and air space insulation; embodies special means of maintaining the air spaces and protecting the walls of the latter against crushing.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. O. B. Shallenberger, Rochester, Pa., 571,849. Filed Nov. 8, 1886.
Comprises a potential reducing converter connected in supply circuit, two or more secondary circuits derived from the converter, consuming circuits connected with the secondary circuits at different points, and translating devices connected in the consuming circuits.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. W. F. Marzahn, Buffalo, N. Y., 571,780. Filed Sept. 21, 1896.
Embodies a drum armature, with ventilating tubes disposed in the ends thereof.
WHEEL WITH ELECTRICAL MOTOR HUB FOR VEHICLES. C. Theryc, Marseilles. France, 572.036. Filed July 31, 1896.
Intended for bicycles.
SPEEDING DEVICE FOR RACE TRACKS. H. G. Wilshire, Los Angeles, Cal., and M. C. Massie, Washington, D. C., 572,080. Filed May 12, 1896.
INDUCTOR DYNAMO. C. P. Steinmetz, Schenectady, N. Y., 11,576, re-issued. Filed May 5, 1896.
Comprises inwardly projecting pole pieces provided with field magnet windings, armature coils mounted upon the polar faces, and a revolving inductor.

Lamps and Appurtenances:—

SWITCH FOR ELECTRIC LAMPS. H. R. Quinby, Rochester, N. Y., 571,791. Filed Dec. 4, 1895.
Hanger-board switch.
ELECTRC ARC LAMP. H. R. Quinby, Rochester, N. Y., 571,792. Filed March 12, 1896.
Feed mechanism for lamps of the enclosed arc type.
ELECTRIC ARC LAMP. C. Eschwel, Long Island City, N. Y., 571,946. Filed Sept. 11, 1896.
Relates to the feed mechanism.
ELECTRIC ARC LAMP. G. R. Lean, Cleveland, Ohio, 571,974. Filed May 23, 1896.
Details of construction.
ELECTRIC ARC LAMP. G. R. Lean, Cleveland, Ohio, 571,976. Filed July 7, 1896.
The combination with a depending arm, and a yoke at the lower end of the arm, of an outer-globe holder removably connected to the yoke, and an inner or arc inclosing globe holder hinged to the arm above the yoke.
CARBON HOLDER. G. R. Lean, Cleveland, Ohio, 571,975. Filed May 23, 1896.
ARC LAMP. J. Rae, New York, 572,064. Filed Nov. 26, 1895.
Enclosed arc type.
GLOBE ATTACHMENT FOR ELECTRIC LAMPS. E. Schrantz, St. Louis, Mo., 571,802. Filed Aug. 15, 1896.
Means for attaching a globe to incandescent lamp sockets.
ELECTRIC LIGHT CORD ADJUSTER. G. L. Gulliford, Bement, Ill., 571,761. Filed May 9, 1896.
A spool shaped electric light cord adjuster provided with slots in its heads which receive the cord, while the slack of the cord is wound on the spool.

Miscellaneous:—

ELECTRIC IGNITING DEVICE FOR GAS BURNERS. G. F. Kreiger, Kiel, Germany, 571,769. Filed May 4, 1896.
Details of construction.
GAME APPARATUS. A. W. Fall, Hoboken, N. J., 571,997. Filed Jan. 7, 1896.
Comprises a water receptacle and a float, constituted in part of magnetizable material and a single rotatable magnet pivoted to the under side of the receptacle.
ELECTRIC FAN FOR VENTILATING STREETS OR ALLEYS. V. V. Hedges. Coffeyville, Kan., 572,008. Filed Nov. 13, 1895.
Comprises a motor, a casing for the same, a shaft driven by a motor, fans carried by the shaft, a support upon which the motor casing is revolubly mounted, and means for making and breaking the circuit by the rotation of the motor casing.

Railways and Appliances:—

ELECTRIC STREET OR STATION INDICATOR. H. Alwies, St. Louis, Mo., 571,738. Filed Aug. 10, 1896.
Comprises a web with the names of the stations disposed thereon, mounted upon rollers and means for operating same at predetermined points by current supplied from the main conductor.
ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 571,832. Filed Feb. 17, 1886.
A track conduit system.
ELECTRIC RAIL BOND. G. H. Short, Worcester, Mass., 571,888. Filed April 23, 1896.
MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES. M. Moskowitz, Newark, N. J., 571,951. Filed July 19, 1895.
Part of system described in The Electrical Engineer, Nov. 25, 1896.
UNDERGROUND ELECTRIC POWER SYSTEM FOR RAILWAYS. W. L. King, Winston, N. C., 572,013. Filed May 21, 1896.
Details of construction.
TROLLEY FINDER. W. J. Donahue and W. B. Hausman, Philadelphia, Pa., 571,994. Filed Oct. 10,1895.
Consists of a wheel having right and left hand grooves increasing in diameter toward the center and merging with the central groove on diametrically opposite sides of the wheel.
ELECTRIC MOTOR RAILWAY TRUCK. J. A. Brill and G. M. Brill, Philadelphia, Pa., 571,825. Filed June 25, 1888.
The combination with the axle box frame, of a motor sleeved at one end on one of the truck axles, a cross bar extending between the side bars of the frame, and a connection for the free end of the motor to the cross bar.

Regulation:—

SYSTEM OF ALTERNATING CURRENT REGULATION AND DISTRIBUTION. B. G. Lamme, Pittsburg, Pa., 571,836. Filed April 6, 1896.
Comprises an alternating current generator, feeders supplied thereby, a direct-current circuit and a rotary transformer having a single compound wound field magnet and an armature located in the resultant field produced by the compound winding and connected to the alternating current and direct current circuits.
ROTARY TRANSFORMER REGULATION. R. D. Mershon, Pittsburg, Pa., 571,863. Filed April 6, 1896.
Consists in compounding the field of the transformer and establishing a difference of voltage between the same and the generator, which difference decreases as the load upon the direct current side increases.

Switches, Cut-Outs, Etc:—

ELECTRIC SWITCH. J. T. Norton, Boston, Mass., 571,927. Filed Jan. 28, 1896.
A flush push button switch.
ELECTRIC SWITCH. M. Moskowitz, Newark, N. J., 571,952. Filed June 11, 1896.
Adapted for use in circuits between dynamo and storage battery when charging the battery.

Telegraphs:—

TELEGRAPH. L. W. Hildburgh, New York, 571,948. Filed March 5, 1896.
Means to adapt systems employing alternating currents for the simultaneous transmission of two or more messages in the same or opposite directions without the employment of special apparatus.

Telephones:—

APPARATUS FOR MULTIPLE SWITCHBOARDS FOR TELEPHONE EXCHANGES. C. E. Scribner, Chicago, Ill., 571,906. Filed Feb. 7, 1893.

Comprises several pairs of connecting plugs, conductors joining the different members of each pair, branches connecting each of the conductors with one terminal of an operator's telephone, and retardation coils included in the branches.
TELEPHONE. C. E. Scribner, Chicago, Ill., 571,907. Filed Feb. 7, 1893.
Electro-magnetic telephone receiver.
TELEPHONE EXCHANGE SYSTEM. C. E. Scribner, Chicago, Ill., 571,910. Filed Oct. 16, 1894.
Consists of an arrangement of apparatus and circuits for the telephone switchboard adapted for use with either grounded or metallic circuits or with a "mixed system."

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW G. E. PACKED CARD RHEOSTATS.

THE new line of rheostats built by the General Electric Co., and illustrated in the accompanying engravings, are known as packed card rheostats, deriving their name from their method of construction.

To form a unit resistance card a wire ribbon of German silver of definite length and size is wound upon a tube of asbestos formed on a steel mandrel and which, when the mandrel is withdrawn, is flattened and creased in a press to give it the card shape. In building the rheostat any desired number of these unit cards are placed side by side and separated by asbestos. The whole is then clamped by suitable end plates and bolts and forms a resistance section. To increase the radiating capacity of the resistance section iron plates are inserted between cards and project beyond the general surface of the section. The same general structure is followed in all rheostats and motor starting boxes of the packed card type, the cross section and length of the resistance wire or ribbon alone being varied. The use of the flat card allows a very large resistance capacity to be placed in a small space while the creases hold the coils firmly against displacement.

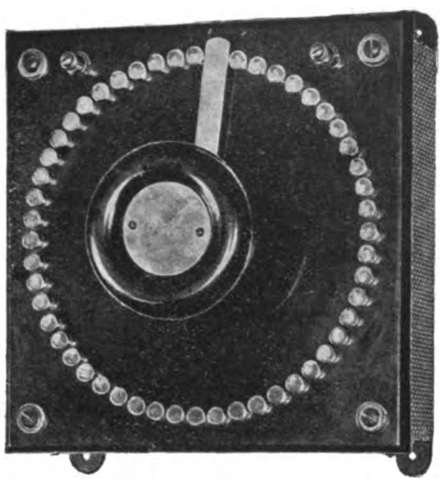


FIG. 1.

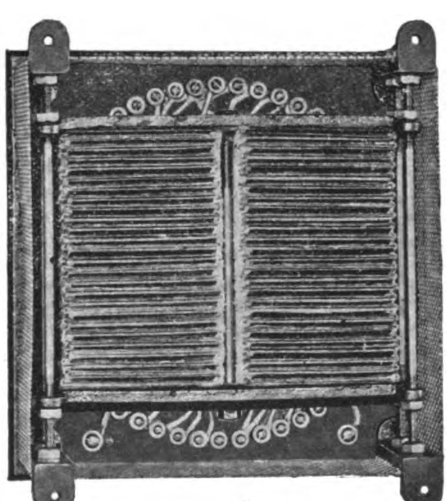


FIG. 2.

The advantages of this method of rheostat construction may be thus summarized. Absence of combustible material, exceedingly large radiating surface for weight and bulk of resistance material, chance of short circuit or similar troubles eliminated by complete insulation of the resistance, easy replacement of damaged cards when necessary, ability of resistance to withstand overloads; it expands and contracts freely, and as the burning of one card only impairs the use of the apparatus until a new one can be inserted, or the old one be short circuited, no overload can destroy the rheostat.

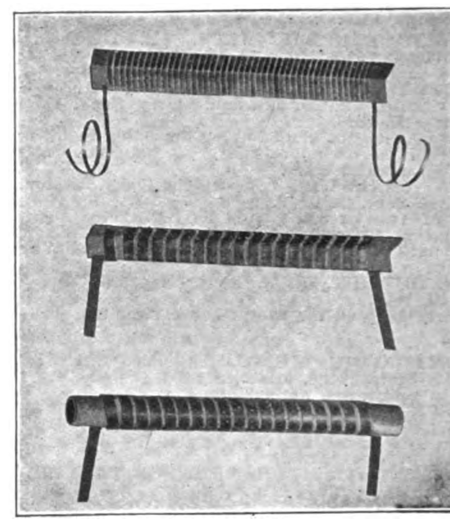


FIG. 3.

The switches used with these rheostats differ with the use to which the device is put. The steps of the field rheostat switches vary in number from 25 to 50—the majority having 50 steps to provide for close regulation—and are mounted on 10x10 inch slate bases. The motor switches, with the exception of the three largest sizes are also mounted on slate bases, the number of steps up to and including 10 horse-power being the same.

The starting rheostats for motors are built with or without automatic release switch, the standard switch being automatic. This automatic release is essential to the successful operation of isolated motors for if the current stops, the circuit is automatically opened and remains open until closed by hand. The motor armature is thus protected against injury by any sudden rush of current, if the supply of current in the mains be suddenly thrown on after having been cut off as sometimes happens with street mains. With the automatic switch the starting resistance is all in as soon as the motor is shut down from any cause.

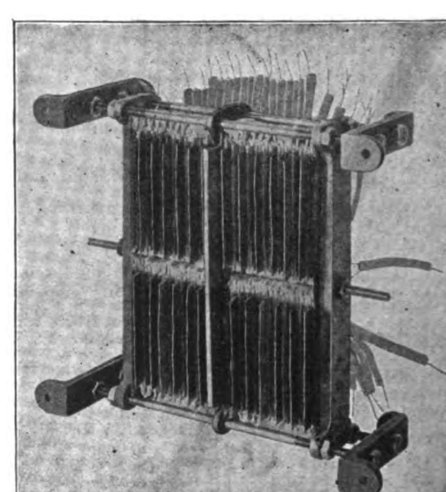


FIG. 4.

The generator field rheostats are constructed to be mounted either in front or behind the switchboard; the motor starting rheostats for the front of the switchboard only. The former are built for 500, 250 and 125 volt circuits, the latter for 110,

Fig. 5.

220 and 500 volt circuits, those for 110 and 220 volts being adapted for use also on 125 and 250 volts.

In the engravings, Fig. 1, shows the standard generator field direct current rheostat, a back view being shown in Fig. 2. Fig. 3 shows the wound tube and pressed card and Fig. 4 the iron plates between the cards. Fig. 5 shows the standard motor wiring direct current rheostat and automatic switch.

THE AMERICAN ELECTRIC HEATING CORPORATION'S FOOT WARMER.

As shown in the illustration, the American Electric Heating Corporation of Boston have just put on the market an electric foot warmer and foot rest combined, of such substantial form and apparent usefulness as to command special consideration from the public. The device generally is of cast iron, finished in black enamel. The heat is applied directly to the under side of the top plate by the enamel process, making

New Electric Foot Warmer.

a durable device that will stand any sort of treatment that it is likely to be subjected to. As it requires but 50 watts it may be attached to any lamp socket by means of the usual plug and cord (with which it is equipped) and can be placed in any desired location about the room or office. It is not inconvenient to move about as it weighs less than 10 pounds, and never reaches a temperature, under any conditions, that would be uncomfortable to handle. In about ten minutes after the current is turned on the foot plate is quite warm and it reaches a maximum temperature of about 145° F. in from 15 to 20 minutes. The working temperature of the device is such that in a very few minutes after placing the feet on it, one experiences a comfortable feeling of warmth, which condition does not change with continued use. In other words, the maximum temperature has been determined by careful experiment as being that at which one can comfortably keep the feet on continuously without producing the disagreeable effect incident to holding them over a register too long. The device is such that it can be used the year round as a foot rest and will add much to the comfort of those sitting continuously at a desk.

It is clear that the foot warmer will have a wide application. There are thousands of people whose occupation confines them in small booths, cashier's offices, ticket offices and the like, through the winter months where it is impractical to have a stove on account of the limited size of the compartment. There are many stenographers, bookkeepers and others who suffer (by reason of impaired circulation) for the want of such an appliance, in rooms which, to one in full vigor, are perfectly comfortable. Invalids and elderly people will not be forced to make others uncomfortable around them with a high temperature in the room if they may keep their feet warm. In cold weather the temperature of a room betwen the surface of the floor and an elevation of a few feet above it is, in most buildings, many degrees different, and it is a difficult thing to so regulate the temperature that one is not suffering from drafts and cold feet or, on the other hand, suffocating from excessive temperature. This device certainly will prove a boon to many.

HOUSTON AND KENNELLY'S "ELECTRICAL ENGINEERING LEAFLETS."

Attention is directed to the important announcement made in our advertising pages, with regard to the Houston & Kennelly Electrical Engineering Leaflets. As is well known, these Leaflets are issued in three series, Elementary, Intermediate and Advanced, meeting the educational necessities of three grades of students. Each book is a handsome volume of about 300 pages, cloth bound, interspersed with numerous cuts, chiefly plain diagrams made specially. The Leaflets have been a great success and have been used everywhere, not only by individuals, but by classes, schools, Y. M. C. A.'s and colleges; often by men in lighting stations and on electric railways. Hitherto the price has been $2 per volume, but henceforth it will only be $1.50, for which price a copy will be sent postage free to any address. All three books in the series can be heartily recommended, either for reading singly, or for successive study as the subject becomes better understood.

CONSOLIDATION OF GAS AND EDISON INTERESTS IN SAN FRANCISCO CO.

A recent special meeting of the stockholders of the Gas Light Company was held, at which the Board of Directors was authorized to organize the San Francisco Gas and Electric Company, upon the terms and conditions agreed upon with the Edison people, and the capital stock of the old company was reduced from $10,000,000, divided into 100,000 shares of the par value of $100 each, to $300,000, divided into 100,000 shares, of par value of $3 each. In entering the new combination the Gas Company stockholders turn over to it all of its street mains and other property used in the manufacture of the illuminant material for $10,000,000 of the stock of the gas and electric corporation. This includes its plants at Howard and Fifth streets, at the Portero and at North Beach, with the site and new office building on Post street, above Powell. There is other property, however, belonging to the Gas Company's stockholders, estimated to be valued at $300,000, which is not included in the deal, the liquidation of which requires that the old corporation shall continue in existence. Among it is land on Second and King streets, the lot on the corner of First and Natoma, and mortgages held on its property adjoining that was sold some months ago. To close these up the San Francisco Gas Light Company will continue under its reduced capitalization until the stock holders are all paid, when it will disincorporate. The Edison Light and Power Company has already agreed to join the combination, it receiving stock to the amount of $2,750,000 and its outstanding bonds, to the amount of $800,000 with interest thereon, making $1,066,000, being guaranteed by stock to that sum in addition, or $3,816,000 in all. The capital stock of the San Francisco Gas and Electric Company will be $20,000,000.

Charles Wirt, 1028 Filbert street, Philadelphia, has appointed as Southern agents, the Electric Supply and Construction Company, Savannah, Ga., who will carry a full stock of Wirt brushes and supply the Southern trade.

CHICAGO FUSE WIRE & MFG. CO.

The Chicago Fuse Wire and Manufacturing Company announce in another column a new catalogue of their well known line of Tested Fuse Wire and Links. Mr. W. R. Goodman, manager of this company, who has been identified with this line for the past eight years, has, by constant and vigorous handling of the business, brought the goods into general use throughout the United States, and to a considerable extent in foreign countries. They further announce that the present outlook for business is very favorable.

THE CALLENDER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

The ingenious automatic telephone exchange system of Mr. Romaine Callender, illustrated in The Electrical Engineer some time ago, has been acquired by the Callender Telephone Exchange Co., Ltd., of Brantford, Canada; capital, $100,000.

Franchises have been obtained in Troy, O., and Piqua, O. Construction has already begun in Troy, and a complete set of apparatus will soon be shipped to that city from Brantford. The work at Piqua will proceed shortly after Christmas. It is said that all the Bell subscribers at Troy will go over to the Callender exchange, and 80 per cent. of those at Piqua. The Callender Co., will shortly move its headquarters to Ohio.

"THE LIVING AGE."

The importance of "The Living Age" to every American reader, as the freshest and best compilation of gleanings from the field of British periodical literature has been long recognized. Founded by E. Littell in 1844, it has never ceased to occupy a prominent place among the foremost magazines of the day. In pursuance of the same general plan adopted by its founder, and to give the best the world can offer, the publishers have arranged for the introduction of certain "New Features" so widening its scope as to embrace translations of noteworthy articles from the leading publications of France, Germany, Spain, Italy and other continental countries, many of which contain matter of great interest and value to the American reader, yet which, for obvious reasons, are absolutely beyond his reach but for the timely help of this delightful medium. In addition a monthly Supplement will be given, containing three departments devoted to American literature. Its prospectus more fully describes these new features, the first of which appears in a November issue.

A year ago the price was reduced from $8 to $6 a year. This reduction brings the Magazine within the reach of a much wider class, and certainly at this price, with these improvements, it is at once the cheapest and the best literary weekly in existence. In no other way can its equivalent be obtained for less than many times its cost. Reduced clubbing rates with other periodicals offer still greater inducements, and to new subscribers remitting now for the year 1897, the intervening numbers of 1896 will be sent gratis. The "Living Age" Co., Boston, are the publishers. "The Living Age" and The Electrical Engineer will be sent to any address at the club rate of $8.50 per year.

ADVERTISERS' HINTS.

C. A. ECK, 157 Oraton street, Newark, N. J., advertises direct current dynamos and motors of high grade in sizes ranging from ⅛ to 10 horse power. They are described very fully in a catalogue which will be sent on request.

THE CENTRAL ELECTRIC CO., Chicago, offer a complete line of X-ray apparatus.

G. A. FREI CO., 17 Bromfield, street, Boston, Mass., illustrate in their "ad." this issue a static X-ray machine for all kinds of X-ray work and demonstrations in static electricity.

THE CAMPBELL AND ZELL COMPANY, Havermeyer building, New York, will send to those desiring it a book entitled "How to Generate Steam Economically," which should be of interest to all steam users.

WM. TAYLOR, 203 Broadway, New York, has considerable to say regarding the points of superiority of Packard transformers.

SCHWEDTLE & SIEBERT, 35 Fairfield avenue, Bridgeport, Conn., manufacture steel stamps, stencils, burning brands, seals, checks, badges, etc.

MR. ARTHUR A. KENT, of the Kent Electric Manufacturing Company, Worcester, Mass., was a visitor to New York City last week attending to business in connection with the small induction motors for fan work, etc., which they are now placing on the market.

NEW YORK NOTES.

WM. TAYLOR, 203 Broadway, has been appointed Eastern sales agent for the well-known Packard transformers.

THE MATHIESON ALKALI COMPANY, of New York City, are to build a large factory at Niagara Falls, N. Y., in which to manufacture caustic soda, by electrical process.

MR. E. P. HOPKINS, electrical expert of J. B. Colt & Co., has been awarded the John Scott medal of the Franklin Institute for improvements in the arc light for the purposes of projection.

IDEAL ENGINES.—The Harrisburg Foundry and Machine Works are building a large engine for the official residence of the president of Brazil, for electric lighting. The engine will be direct connected to a General Electric generator.

"FROM THE MAIL." This is the title of a very clever and pretty little book issued by the Vacuum Oil Co., to help the sale of their lubricating oils for machinery. It opens with a portrait of Mr. Edison and a testimonial from him. There are many others from all over the world, printed in the languages of the respective countries of origin. Those for this country represent many of the leading concerns and apply to engines, dynamos, etc. The book is one of the artistic productions of the Orr Press of Bartlett & Co.

MR. C. B. STERLING has become vice-president of the Standard Electric Lamp and Novelty Company, 248 West Twenty-third street, and has started on a long western trip to deal with the many inquiries and requests for agencies that have reached the concern. Mr. Sterling is well known from his connection with the Central Electric Heating Company, and other electrical enterprises. The field for miniature lamps, Crookes tubes and other specialties made by the company is large, and with the brightening prospects of general trade is likely to be larger.

NEW ENGLAND NOTES.

THE CONNECTICUT TELEPHONE AND ELECTRIC CO., of Meriden, Conn., have issued a very neat and tasteful catalogue of their new telephonic apparatus. It is their second catalogue and exemplifies steady growth and improvement in all branches. The first part of the pamphlet is devoted to transmitters, of which a large variety are shown, and then come receivers in equal profusion, all with details and prices for the different styles. Other portions of the book describe switchboards, batteries, switches, lightning arresters, etc., and numerous testimonials are quoted. The concern will be glad to receive inquiries as to private lines or exchanges.

THE UNION TRACTION COMPANY, of Rutherford, N. J., are to erect a new power house and car barn. The entire contract for this work has been let to the Berlin Iron Bridge Company, of East Berlin, Conn. The buildings will be of brick with steel frame work, and the plant when completed will be up to date in all respects. The car barn is 97x100 feet, adjoining which will be the offices, store rooms and repair shop. The engine room is 50x65 feet, and the boiler room 40x65 feet. The roofs are supported on steel trusses, and the covering is to be corrugated iron throughout. The roof of the engine house is lined with the Berlin Company's patent anti-condensation fireproof roof lining, which always gives proper protection against fire and condensation, and is in fact the only lining which has stood the test in use for roofs of this nature.

WESTERN NOTES.

THE BARNEY & SMITH CAR CO., of Dayton, Ohio, have completed and delivered to the B. & O., 10 combination baggage and passenger cars. These cars are of the latest design, being equipped with gas, heated by steam, and painted blue, and are 60 feet in length.

MR. E. M. HARRISON, in the Harrison International Telephone Company suits, has filed a long answer in regard to the allegations of fraud and wrecking, and claiming that he was induced by the misrepresentations of his associates on the board of directors to participate in their irregular actions.

SOUTHERN NOTES.

MR. T. H. RUSSOM has been appointed General Car Foreman of the Mt. Clare shops, B. & O., vice Mr. C. H. Williams, resigned.

THE CAMPBELL & ZELL CO., the well-known boiler-making concern of Baltimore, was put in the hands of a receiver last week, owing to the difficulty of collections, etc. The assets are put at $432,000 and liabilities at only $163,000. The large business is being carried on as usual.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

Vol. XXII. DECEMBER 9, 1896. No. 449.

ELECTRIC LIGHTING.

THE NEW ELECTRIC LIGHT AND RAILWAY POWER STATION OF THE EDISON ELECTRIC ILLUMINATING CO. OF PATERSON, N. J.

INTRODUCTORY.

LINKED with the history of Paterson, N. J., is the name of Alexander Hamilton, who realized immediately after the Revolution that manufacturing industries were necessary to utilize our raw products, and supply those manufactured articles which had been previously shipped to us by England. He selected Paterson as a natural manufacturing center, it having the advantages of considerable water power and close proximity to the metropolis of the country. Under his guidance the water power was improved and made valuable; the factories soon outgrew the capacity of the water power, and the city of Paterson became dotted with factories of all kinds, the silk industry taking the lead. There are over one hundred silk mills in Paterson now, and it has been called "the Lyons of America." Among the other prominent products at the present time are locomotives, structural iron and flax thread.

Early in the art Paterson was supplied by electric light from the Hochhausen system. In the year 1888 this system was bought by the Paterson Electric Light Company, who installed the Thomson-Houston arc and series system for municipal lighting, and also a duplicate of the Edison three-wire system for power and domestic lighting.

FIG. 3.—A CORNER OF THE BUSINESS OFFICES.

Later in the same year the Edison Electric Illuminating Company, of Paterson, were formed in competition with the Paterson Electric Light Company, and they installed a three-wire plant, operating under the Edison patents. They located their station on Paterson street, near Market, and it was constructed according to the best engineering practice of that date, and has always proved a very profitable investment. To compare the station of 1888 with the station of 1896 has a historical value and shows great progress in every department of equipment and construction of lighting and power stations.

A fierce competition was carried on between these two companies, which resulted in the Edison Company absorbing its rival in April, 1890. Since that time both stations have been operated by the Edison Electric Illuminating Company, using the old Paterson Electric Light Company's station only as an arc light plant, and the Edison Company's as a combined lighting and power plant.

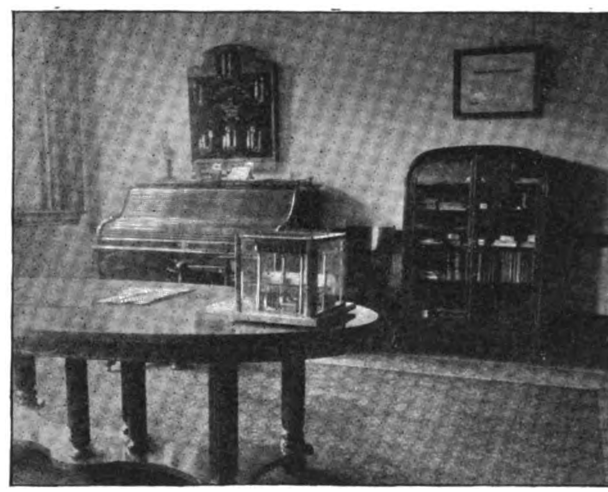


FIG. 4.—OFFICE OF THE GENERAL MANAGER.

With the advent of electric railways, the Edison Company made a bid and succeeded in securing all contracts to supply, with power, the railways in Paterson and its vicinity. Under conservative management, the business increased so rapidly that at a meeting of directors, in the latter part of the year 1894, it was decided that Mr. William Brock, general manager of the Edison Electric Illuminating Company, of Paterson, make a report on the best method of meeting the increasing demand for power and light, which was taxing the two stations to their utmost capacity. As a result of this report, it was decided on account of abundant water for condensing, and because the site was nearer the center of distribution of the Paterson system, to locate the plant near the Passaic River, and on one of the raceways from the Passaic Falls. The location secured was at the corner of Van Houten and Prospect streets, where one of the largest plants of its kind in the United States is now located.

THE STATION BUILDING.

Our engraving, Fig. 1, shows an exterior view of the new station building, which is of selected Haverstraw brick, with blue stone trimmings. The total length of this building is 384 feet and the width 92 feet. Fig. 2 shows the plan of the station and raceways around the building, as well as the location of the engines, dynamos and boilers. This arrangement was laid out by Mr. William Brock, and the building details were developed with the assistance of Mr. J. W. Ferguson, of Paterson, N. J., who was also the contractor for the entire structure. All the brick is laid in cement mortar. The contract for this building was let on August 1, 1895, and it was completed and turned over to the owners on February 1,

1896, which was remarkably quick time, considering the stability and character of the structure. It required over 80,000 bricks to be laid a day, in order to complete this building within the specified time.

In the ground plan, Fig. 2, it will be noticed that the executive building occupies the front of the structure. It is 70x55 feet, with three stories and basement, and with a wire tower 20 feet square and 81 feet high. The offices, meter-room, storeroom and exhibition room, are on the first floor, while the general repair shop and storerooms, as well as the armature winding department, occupy the two upper stories, which are reached by an electric elevator.

The main entrance to the building is through the wire tower. The walls of this tower are lined with wiring ducts, which are concealed by being overlaid by fancy tiling, and reach from the cellar to the top story, where the distribution boards and lightning arresters for the overhead system are placed .The stairs winding around this tower give another method of reaching the upper floors. A general view of the offices is given in Fig. 3, and that of the general manager's office in Fig. 4. Of course, the main interest in a structure of this kind centers in the engine room. The whole back of the office and storeroom section is solid masonry, the only opening between the engine room and the office building being a door on the office room floor. This forms a perfect fire wall, and divides the semi-combustible structure from the non-combustible structure, there being no combustible material used in the whole engine room or boiler room, or in any of the appliances, except the window frames, and such precautions have been taken in this part of the structure that it is very doubtful whether the company are not justified in saving their insurance premium.

THE FUEL SUPPLY AND UTILIZATION.

The station has been built from the investor's standpoint, and every means that could be adopted to improve the operation and reduce the cost of production of current has been carefully studied and adopted, if it warranted the investment; consequently, in describing those methods and appliances which have been adopted, it is more logical to start at the beginning of the process and note the interesting and special points in this plant, as they occur in the process of current generation.

The coal used is low grade "buckwheat," and it is delivered in the conveyor hopper, Fig. 5, across the raceways from the boiler room, shown in section Fig. 6, and conveyed to a 1,200 ton bin in the top of the boiler room. The conveyor, put in by the Hunt Conveyor Company, continues its course and passes underneath the boiler room floor, where the ashes from the boiler are delivered automatically to the conveyor, and carried to an elevated ash bin, from which the carts are loaded by a chute. The coal on leaving the storage bin passes into a weighing bucket, there being one for each boiler, where it is retained and weighed before being discharged on the boiler room floor, and where it is for the first and last time handled manually when being thrown on the grate. These boilers are provided with a shaking grate, and the ashpit slopes away toward the conveyors so that there is no cleaning to be done underneath the firebox.

Enough coal may be uselessly passed between the coal pile and boiler by careless firing, which, if saved, would pay a div-

FIG. 1.—THE NEW LIGHTING AND RAILWAY POWER STATION OF THE EDISON ELECTRIC ILLUMINATING CO., PATERSON, N. J.

idend, and hence special attention was devoted to this part of the plant. On opening these boiler doors, an ideal fire about an inch and a half thick, is seen, with a four-inch streamer flame uniformly distributed over the whole grate surface, the natural draught being used without choking, and the resultant gases from combustion being transparent.

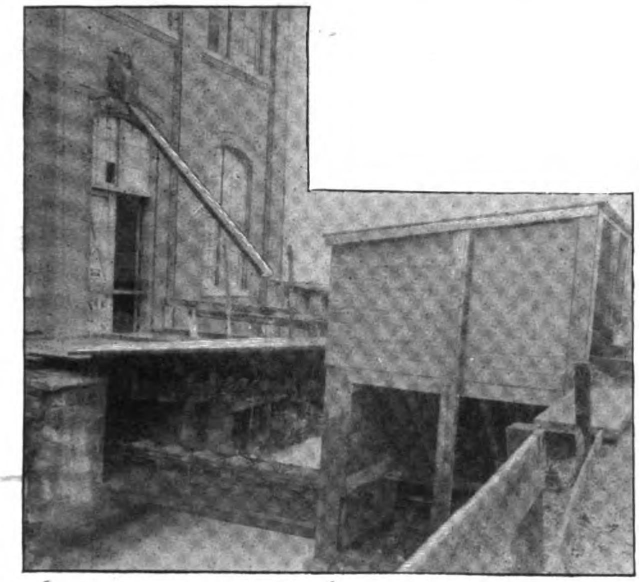


FIG. 5.—COAL HOPPER AND CONVEYOR.

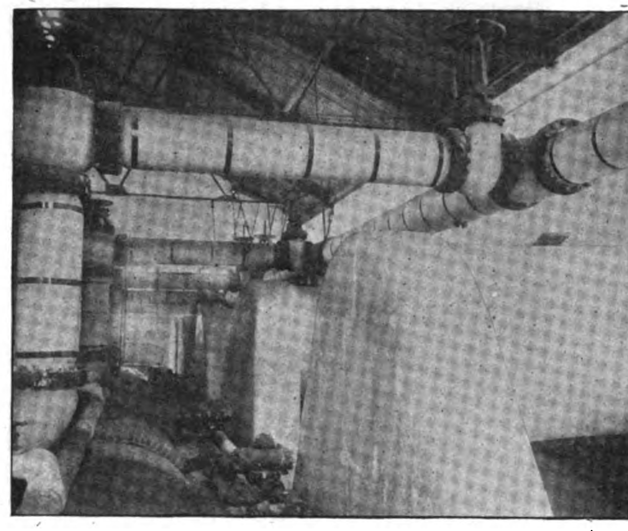


FIG. 8.—STACK CONNECTIONS AND BREECHINGS.

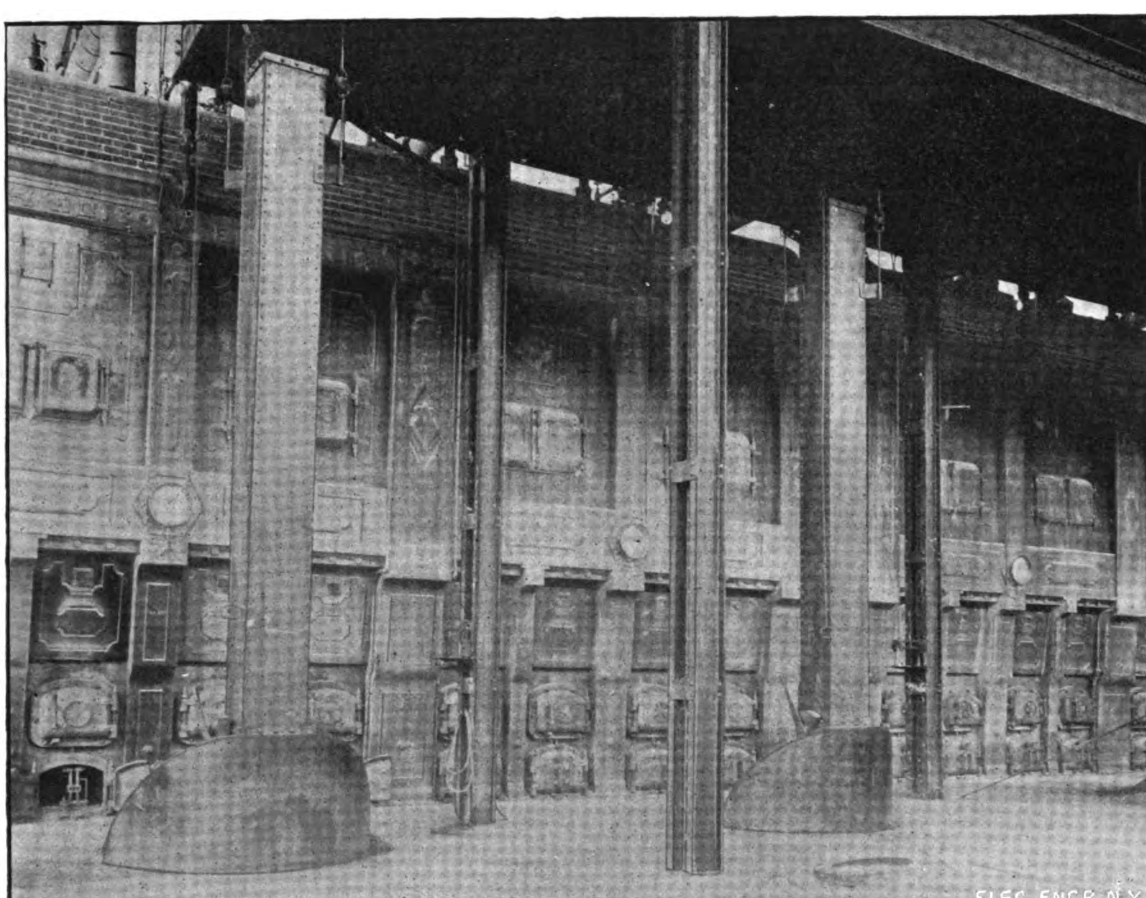


FIG. 7.—VIEW OF STIRLING BOILERS, EDISON ELECTRIC ILLUMINATING CO., PATERSON, N. J.

THE BOILERS AND SMOKE STACK.

The boilers are of the Stirling type, shown in Fig. 4, and of 500 horse-power each, run at 150 pounds pressure. The present battery consists of six boilers, and the future extensions provide for a duplicate battery. The gases, after all the heat that can be is extracted from them on passing around the boiler tubes, are again passed through a Green economizer, where the hot gases circulate through a system of tubes and heat the feed water, and are again reduced in temperature before reaching the foot of the stack. The storage of energy in the feed water allows the boilers to respond readily to a sudden call for steam. If the gases are still too hot, they are impeded in their course up the chimney by means of an automatic damper regulator.

The heat radiated from the stack connections and breech-

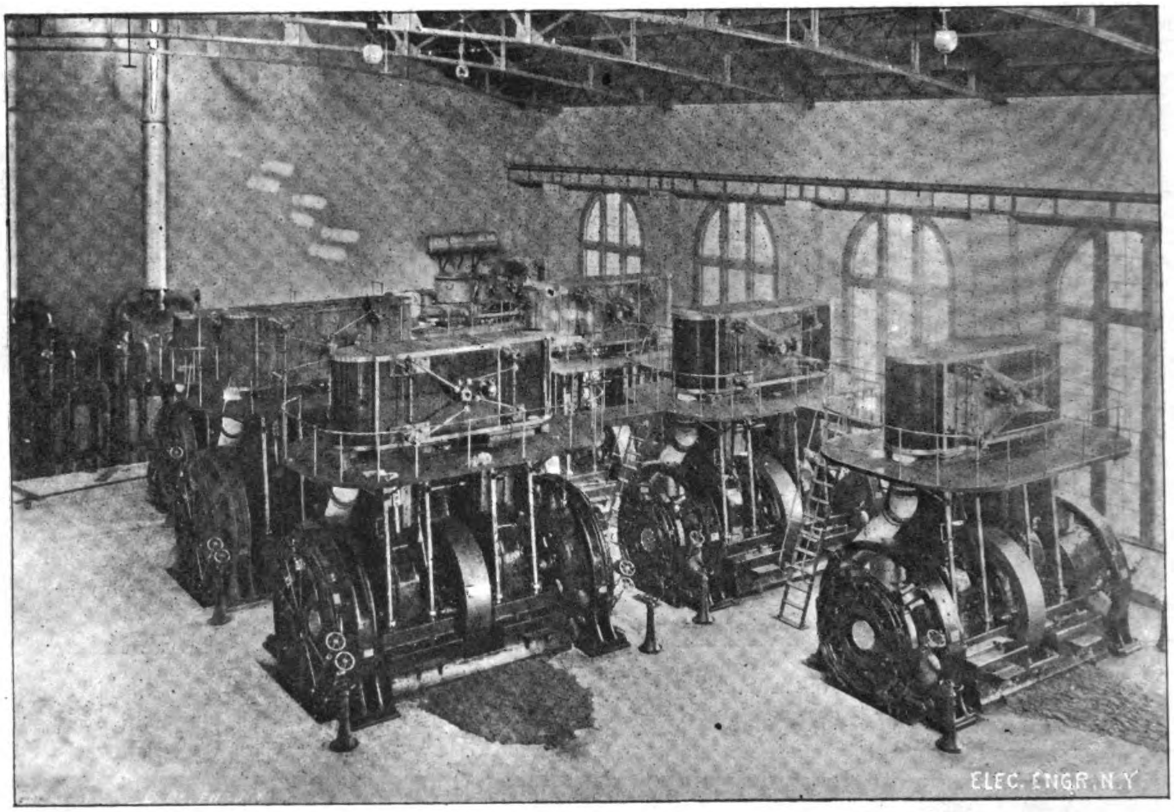
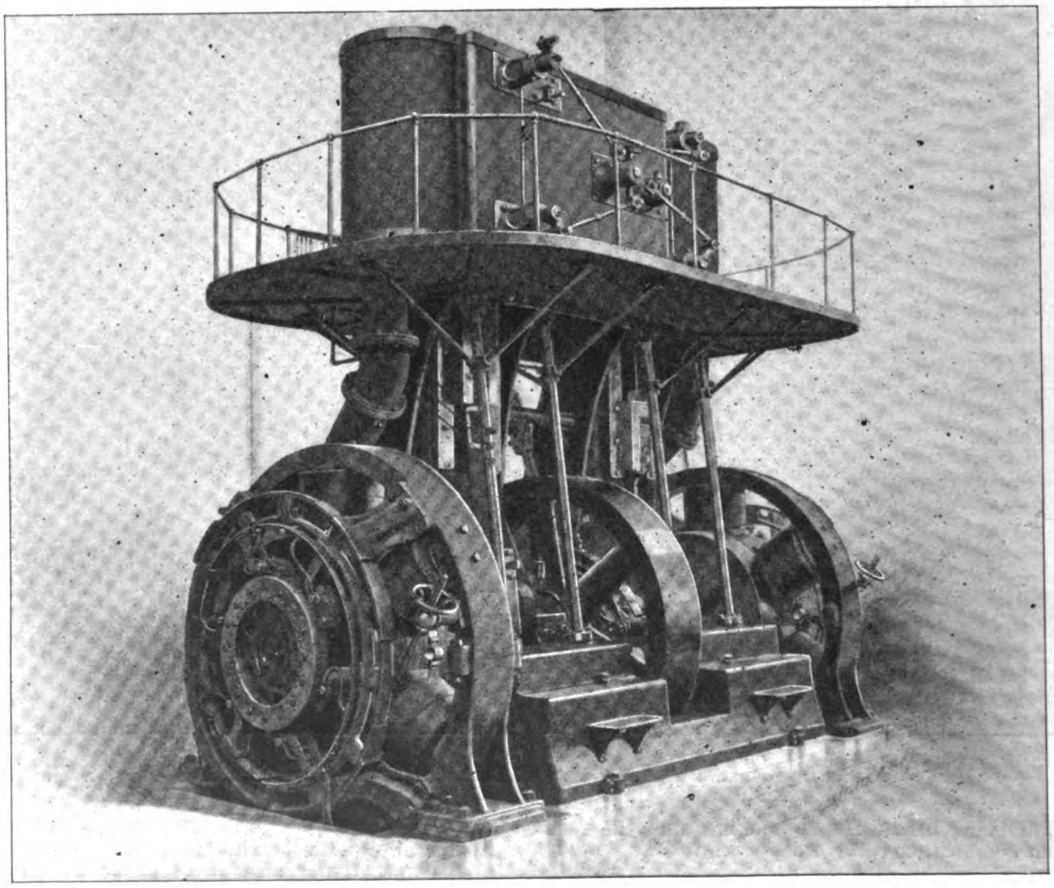


Fig. 10.—Edison Electric Illuminating Co., Paterson, N. J. View of Engines and Generators from Controlling Gallery.



ig. 10a. —Ball & Wood Compound Condensing Engine, Driving General Electric Railway Generator, Paterson Edison Station.

ings is largely saved by having them covered with a fireproof covering, as shown in Fig. 8, their treatment being the same as that used for steam piping. Heat is again saved here, which more than pays the interest on the investment. The

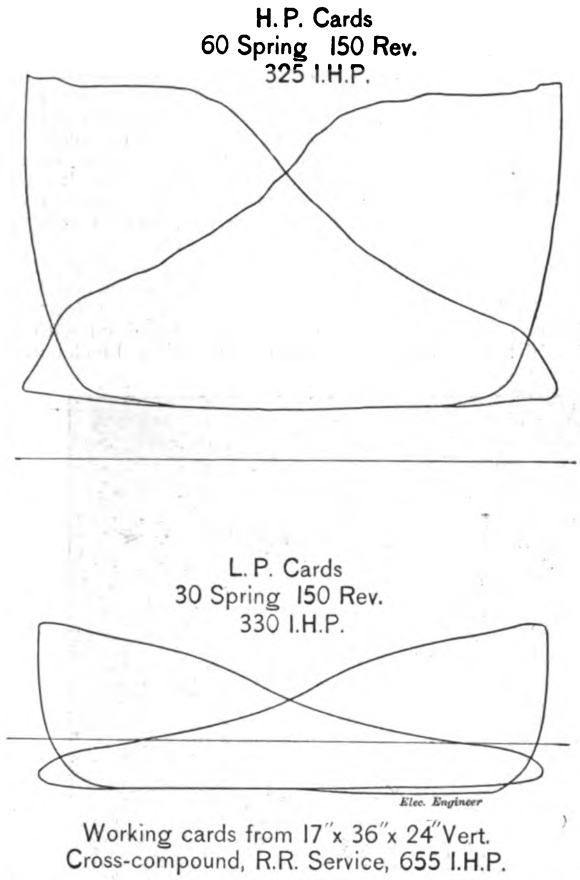


FIG. 11.—INDICATOR CARD FROM BALL & WOOD COMPOUND CONDENSING ENGINE.

water supplied to the boiler is taken from the hot well by two Worthington pumps and forced through the Greene economizer, thus reaching the boiler at a temperature of 250 degrees Fahrenheit. Every boiler is provided with a hot water meter, which has a by-pass around it, so as to be readily taken out of service for recalibration, and there is a main hot water meter to again check these individual boiler meters. All drips and entrained steam are also metered before being delivered to the boiler by traps.

As the performance of the boiler is the relation between the water it evaporates and the coal it burns, this relation can be determined every day for each boiler by reading the water meters and taking the weight of coal burned. These results excite considerable interest and also competition between the different firemen, resulting in better firing and less coal consumption for the output.

The dumping grates under the boilers are of the "Common-Sense" type, furnished by Messrs. Hine & Robertson, who also supplied the steam engine indicators and planimeters.

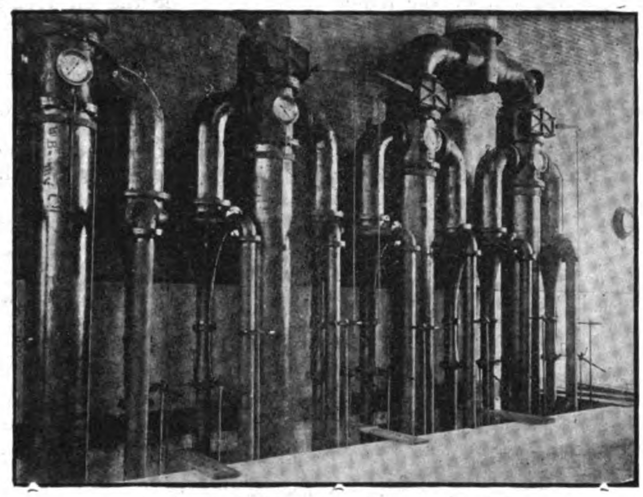


FIG. 12.—THE BULKLEY CONDENSERS.

To increase the draught beyond the natural draught of the chimney, which is now 1 inch of water, a blower is used, consisting of an engine directly connected to a rotary blower, furnished by the Kensington Engine Works. Besides the general economy of this arrangement, an artificial draught for an electric light station has the additional value that it enables the firemen to steam quickly for a rapidly increasing load, which is often caused by cloudy or foggy weather, and in this way brings on suddenly a heavy lighting load. At such times the blower can be used for forcing the draught with great advantage, as at these times the atmospheric conditions are usually extremely unfavorable to a natural draught. All boilers are provided with Henderson's angle check valve, which only allows the boiler to connect to the main pipe when the pressure is up to the main pressure, and which closes off any boiler if the pressure in it falls rapidly.

The smokestack is the highest but one in the State of New Jersey, and its construction deserves special attention. The

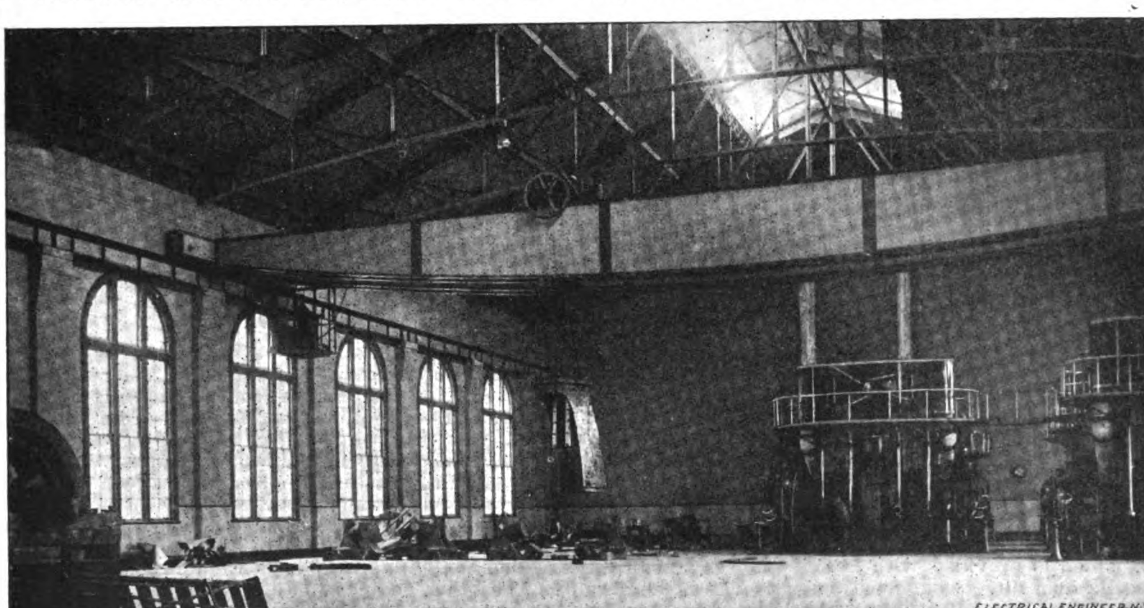


FIG. 14.—20-TON CRANE, 92-FOOT SPAN, IN PATERSON EDISON STATION.

height from the foundation to the top is 235 feet, with a 10-foot flue, and its diameter at the base is 22 feet; the other dimensions will be found in the detail drawing, Fig. 9. The foundation on which it is built is piling driven into the earth and over this is laid 5 feet of concrete. The chimney is double walled for 130 feet 9 inches, and at every 15 feet a wrought iron ring is set into the brickwork, in this way bonding the chimney together. There were 900,000 bricks used in the construction of this chimney, and an electric hoist was used during its construction, no outside staging whatever being employed. The material was hoisted on the interior of the chimney.

In passing out of the boiler room, we enter the oil room, where the oil circulating system terminates from all engines and dynamos in the building. Here the oil is filtered before being forced, by means of compressed air, up to the gravity tank, where it is again circulated through the oiling system. The rest of this room is provided with lockers, lavatory and bath rooms for the employés.

The boiler room being 15 feet 6 inches lower than the engine room, it gives a natural drip system to all steam piping, which is of wrought iron, screwed and expanded into cast iron flanges. These flanges are bolted together and have as a packing corrugated metallic gaskets. The piping is protected from radiation by the H. W. Johns Company's fire covering. The steam valves were furnished by the Eaton, Cole & Burnham Company.

THE ENGINE EQUIPMENT.

Above this room on the engine room level is located the machine shop, which is provided with lathes, planers and drills, each having its own direct connected motors. The machinery has been so selected that all fittings and repairs necessary for the plant can be made here.

The engine room is 92x206 feet, the walls are 31 feet from the floor to truss, and the total capacity is 15,000 horse-power.

All the engines are of the vertical marine type, Fig. 10, built by the Ball & Wood Co., of New York. The engine equipment now installed is as follows: Four 600 horse-power compound condensing engines for railway work, with 140 pounds of steam pressure and 150 revolutions. The high pressure cylinder of each engine is 17 inches in diameter, the low pressure cylinder 36 inches in diameter, and the length of stroke 24 inches. Each engine is capable of delivering 625 horse-power without vacuum. The valves of these engines are of the Corliss type, double ported. Their location forms one of tne novel features in the engine, and reduces the idle steam clearance to 3 per cent. The steam exhaust valves are at the top and bottom of the cylinder instead of at the sides, and the valve can be raised from its seat by any undue pressure which may be caused by water being entrained in the cylinder, no strain being thrown on the engines from this cause. The valves are actuated from a wrist plate, which is connected by means of link and eccentrics to the governor. This latter is of the inertia type, in which the eccentric is part of the inertia mass distributed in the fly-wheel. The forces which actuate the eccentric are large and are extremely sensitive to the slightest changes of speed. All moving surfaces are oiled by a continuous gravity system, and oil is delivered to the crank pin by a centrifugal oiling device. The four pillow blocks on which the main shaft rests are provided with movable babbitt liners, and the two center pillow blocks are provided with adjustable wedges, and their adjustment can be effected while the engine is in operation if necessary. Fig. 10 A gives a view of the engine room from the regulating gallery.

The card of the engine, Fig. 11, shows very little wire drawing, and the steam in passing between the high and low pressure cylinders is superheated by means of live steam coils before entering the low pressure cylinder. The steam from the low pressure cylinder is exhausted into the condenser, which maintains a 26-inch vacuum.

The other engines in this plant are of the same type, and there are two 600 horse-power engines, identical in dimensions and speed with the above, for the low tension three-wire system, and one 315 horse-power compound condensing engine running at 180 revolutions with 140 pounds steam pressure.

For the arc lighting system two 700 horse-power compound condensing engines running at 130 revolutions per minute, with 26-inch vacuum, are employed. The high pressure cylinder is 20 inches in diameter, the low pressure cylinder 41 inches and the length of stroke 24 inches. This engine connects by

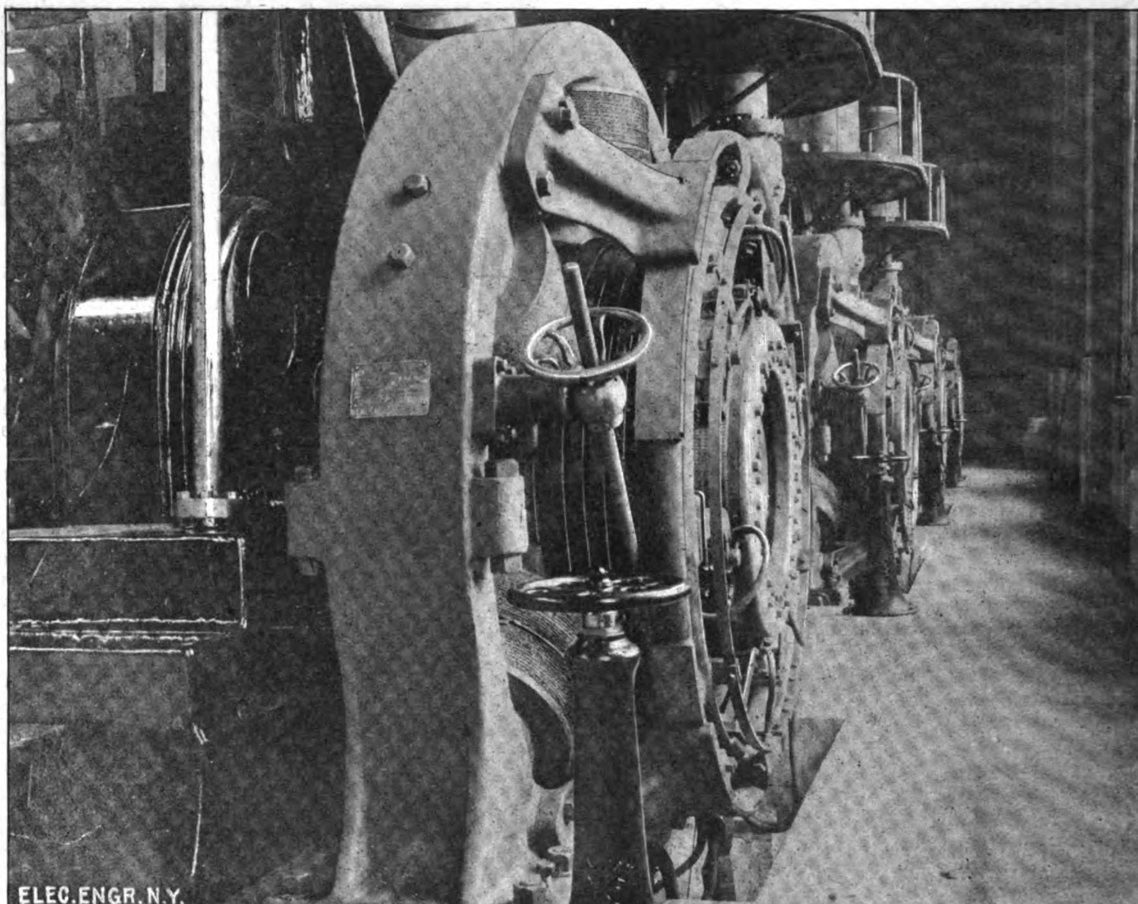


FIG. 15.—VIEW OF RAILWAY GENERATORS, PATERSON EDISON STATION.

means of a rope drive to the quill for the arc lighting machines. All the cylinders in these engines are provided with steam jackets and are guaranteed to deliver an indicated horse-power hour, for 15½ pounds of dry steam. These engines are designed to give their maximum efficiency at 80 per cent. of their full load, and it will be noticed from the load curves that this will be their average duty. The steam traps were furnished by the Albany Steam Trap Company.

THE CONDENSING APPARATUS.

Each pair of engines exhaust through an 18-inch pipe into two Bulkley injector condensers, of which there are now eight in all, located about 34 feet above the water level in the hot well, as shown in Fig. 12. The condensing water flows through a 30-inch main, under a head of about 22 feet, a separate vertical pipe leading to each condenser. After the vacuum is started by a pipe from the city water pressure, the water is syphoned over into the condensers, entering them in a thin circular film. The exhaust steam thus enters a hollow cone of moving water, and in condensing, imparts to it a velocity that enables it to expel the air and vapor through the contracted neck of the condenser, into the discharge pipe below. A vacuum of 27 inches or more is thus maintained at no cost, as the water right goes with the property. Should the water supply from the raceway fail, the condensers will then be supplied from the Passaic River by direct connected centrifugal pumps.

ENGINE ROOM CONSTRUCTION AND ACCESSORIES.

The floor of this station presents novel features of construction. It provides for both a fireproof and an insulated structure. Fig. 13 shows the cross-section of this floor with the ribs of cement moulded underneath the flooring. Inserted before the cement is tamped in position are two twisted 1-in. iron rods, one in the upper part of the rib or web, and one in the lower part. Moulds of wood were used to form the cement floor, which, after the cement had set, were removed. The floor was subjected to a test after two weeks, with a load of 400 pounds per square foot, and it showed no deflection or cracking. This floor was laid by Jacob Sharp, of Paterson, N. J., and on being treated with ozokerite, will be a fair insulator, so that the attendant will be protected from shocks while adjusting brushes.

All assembling of engines and dynamos and handling of material was done by a 92-foot 20-ton Shaw crane, shown in Fig. 14, which can handle material in any part of the engine room or switchboard gallery. Two McClelland combined oil purifiers and storage reservoirs are in use, furnished by the McClelland Oil Purifier Co.

THE RAILWAY AND INCANDESCENT GENERATORS.

Each engine is directly coupled to two six-pole, 225 kilowatt, 150 revolutions, 500-volt generators for railway work, built by the General Electric Company, having a total output of 820 amperes and 550 volts. Fig. 15 shows a perspective view of these dynamos on one side of the engines. There are four sets now installed, with a total output of 3,280 amperes. The armatures are overhung, and each pair is supported by four bearings having ample wearing surface, so that there will be no appreciable wear, nor does the shaft show any deflection. It is interesting to note here that the ultimate output of this plant would have been cut down 20 per cent. if outboard bearings had been necessary. Fig 10 A shows the unit complete.

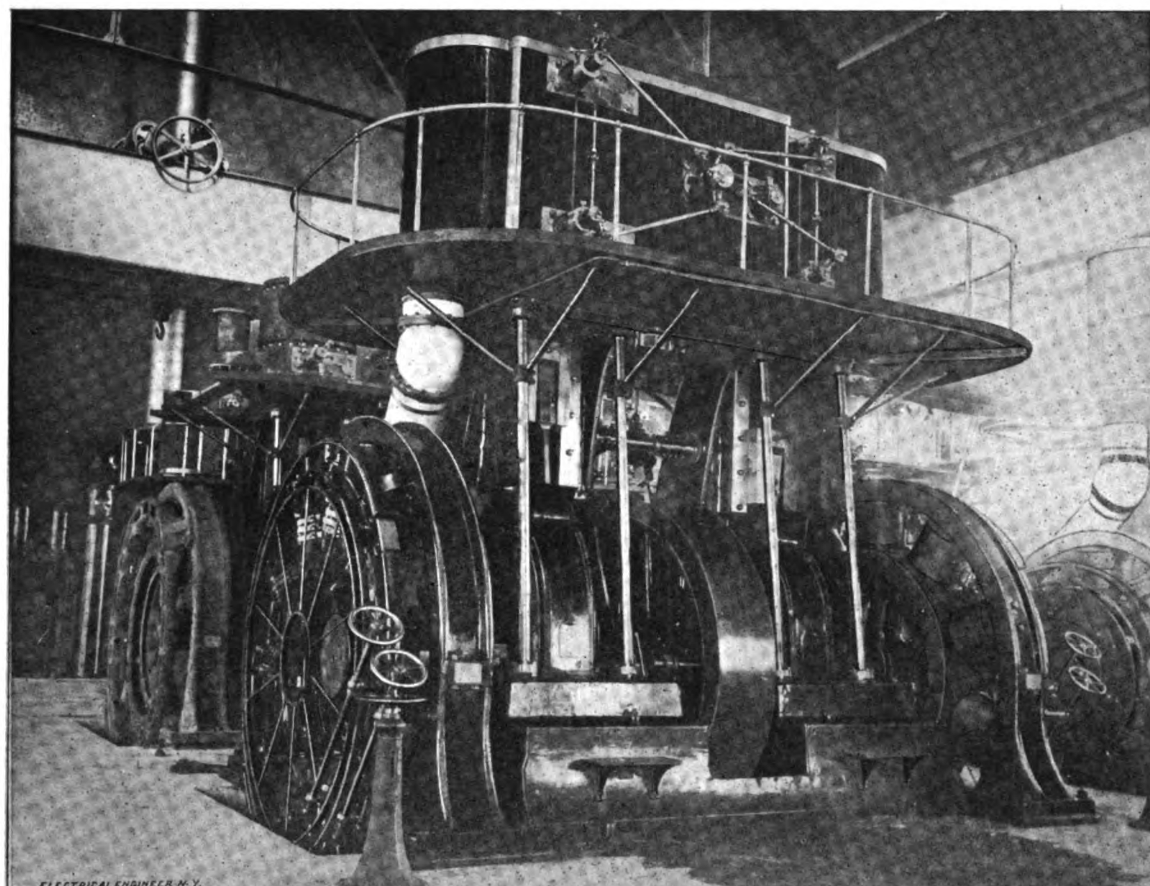


FIG 16.—GENERAL ELECTRIC INCANDESCENT GENERATOR UNITS, PATERSON EDISON STATION.

The armature of these generators is of the slotted, ventilated type, with developed surface winding, and with radial carbon brushes, which are all mounted to a brush holder rig which can be adjusted by screw and handwheel. These generators are 10 per cent. over-compound.

Four of the incandescent dynamos are of the ten-pole, 200-kilowatt, 150-revolution, General Electric type, Fig. 16, overhung and connected to the same style of engines as those driving the railway generators. The armatures of these machines have a smooth body and have a two-path winding. The side of the armature is used as a commutator, and gauze brushes bear directly on the armature winding. There are two units provided with two 200-kilowatt generators each, and one unit directly connected with two 100-kilowatt generators, with a total output of 6,660 amperes.

THE ARC GENERATORS.

The arc light plant, located on the west side of the building,

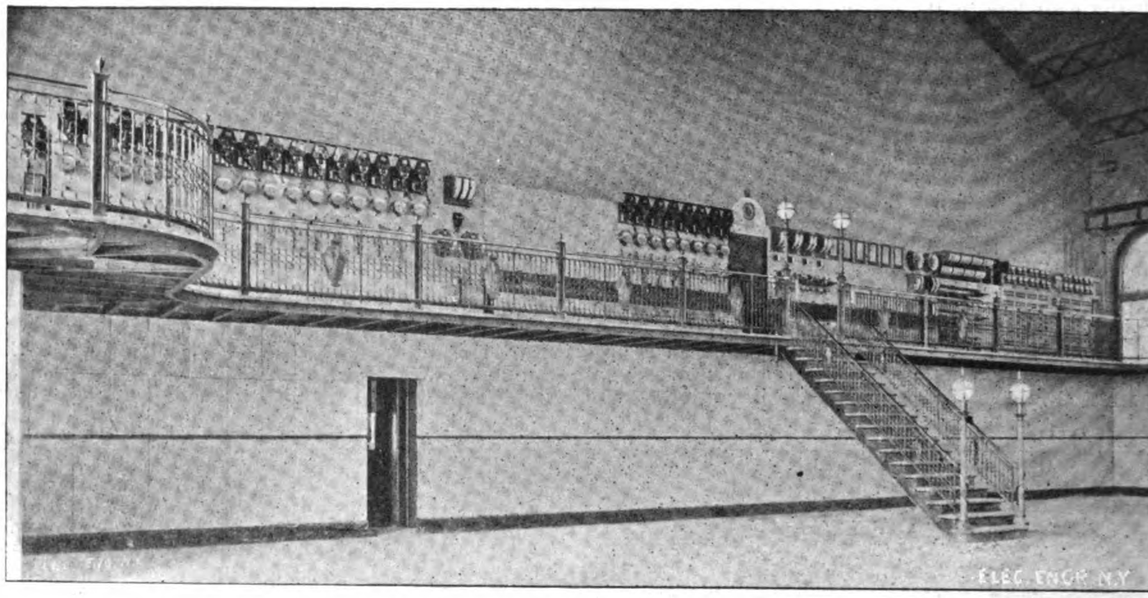


FIG. 17.—THE SWITCHBOARD GALLERY, PATERSON EDISON STATION.

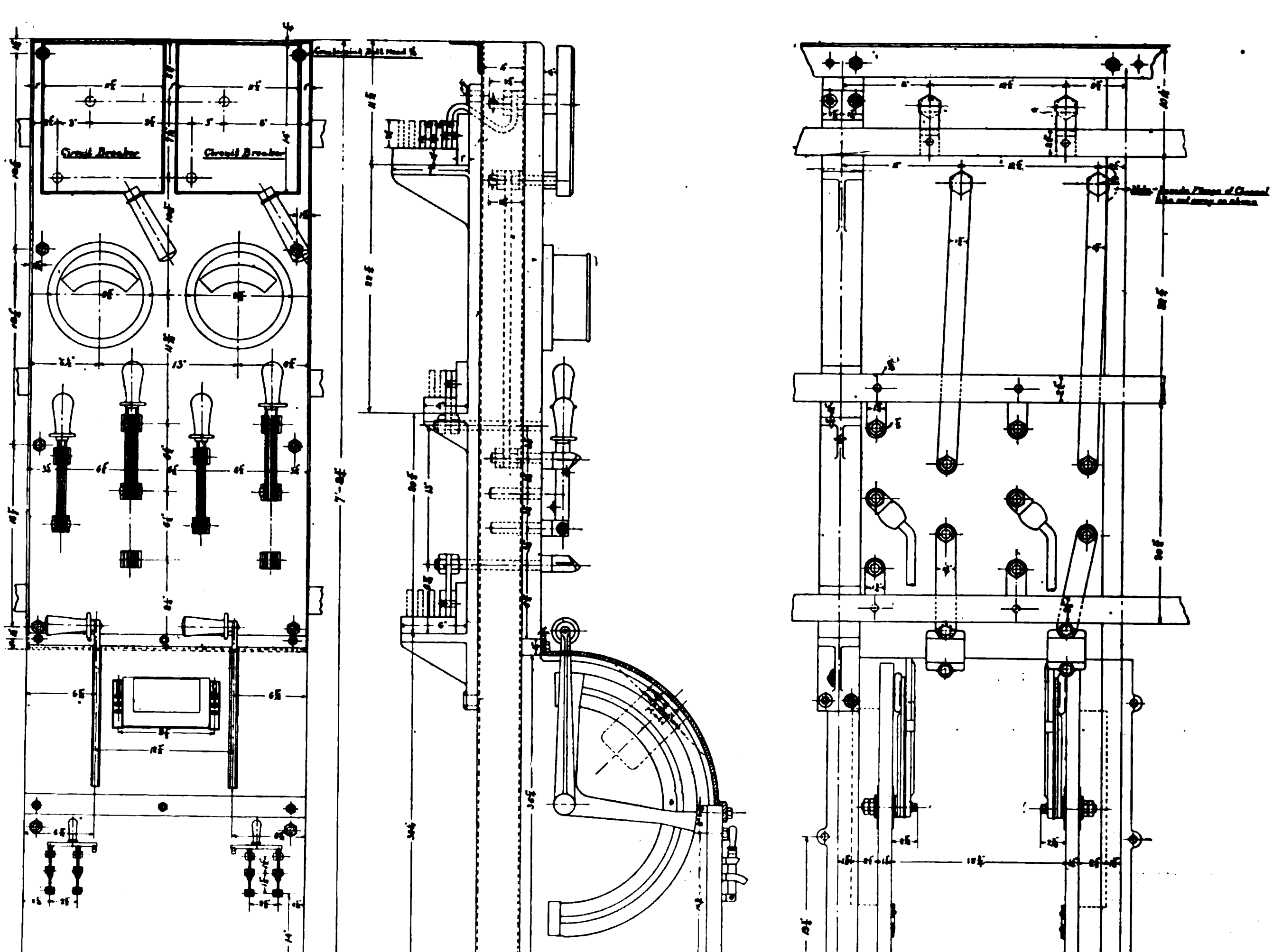


FIG. 18.—DYNAMO RAILWAY SWITCHBOARD, PATERSON EDISON STATION. FRONT, SIDE AND REAR VIEWS.

Designed by Messrs. Herrick and Burke, Consulting Engineers.

consists of nineteen 50-arc light machines and four 125-arc light machines. These are of the Brush and Thomson-Houston type, and are connected by belting to a continuous quill by Hunter friction clutches. This quill passes through the center of a hollow shaft, to which is secured the driven pulley from the engine. The driving gear from the engine is

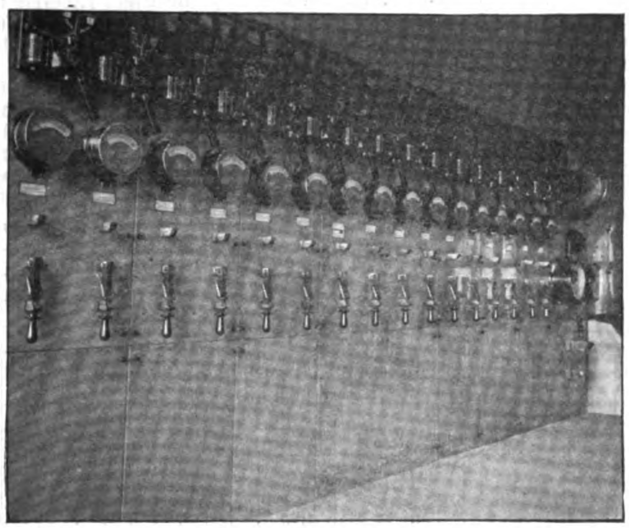


FIG. 19.—THE RAILWAY FEEDER SWITCHBOARD.

rope, provided with the Hoadley transmission system, which consists of a continuous rope, several turns of which are carried around the helical groove of the driven pulley, in order to increase the adhesion between the pulley and rope, and a slack loop is held under the tension by means of a tension pulley, and the same pulley also passes the rope back to the beginning of the driving pulley spiral. The driven pulley from the engine is also provided with a friction clutch, so that any dynamo can be run from any engine.

The compressor used for the oil circulation system is also used for blowing out dynamo armatures, hose and nozzle be-

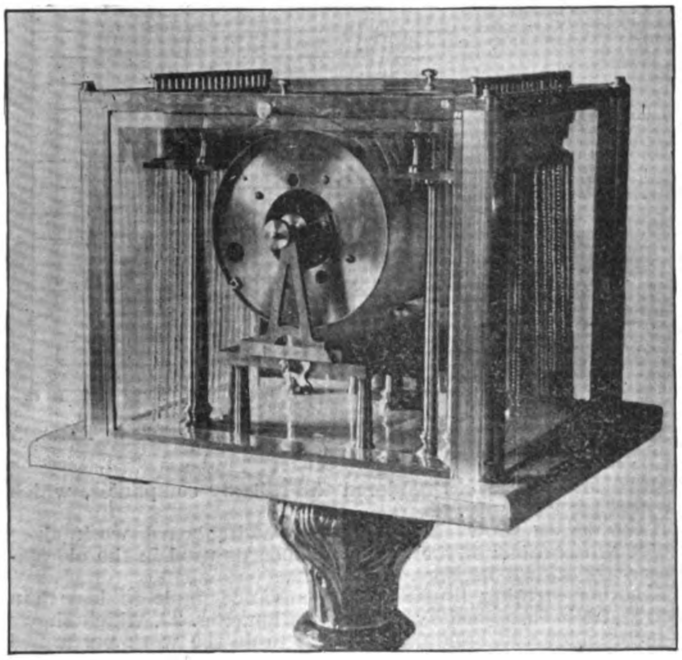


FIG. 20.—TIME RECORDER FOR RAILWAY FEEDERS.

ing used for the purpose of reaching all the parts of the armature, and after the dynamo has been shut down the attendant is required to clean all armatures by the air blast. All conductors from the generators are carried underneath the floor by means of split porcelain insulators secured to iron work under the floor, and these conductors are insulated with fireproof covering, so as not to be a conductor of fire or to increase the fire hazard. They pass up behind the wall under the gallery to the switchboard.

THE SWITCHING AND REGULATING APPARATUS.

The switchboard occupies a gallery 92 feet long, shown in Fig. 17, extending across the north end of the building and 10 feet above the engine room floor, and is reached by a stairway, so that the switchboard attendant has a view of all dynamos and engines in the plant. The supporting structure under the switchboard is iron framework covered with artificial marble. The beams for the gallery floor have a footing in the wall, and the platform in front of the switchboard is overhung 5 feet, forming a cantilever structure; there is 4 feet of space behind the board, giving ample space for all conductors and passageway. The gallery floor is of selected slate, the ironwork supporting the switchboard marble is all insulated from contact with the iron structure of the gallery, being built up on marble, and the iron frameworks of the different switchboards are again insulated from each other. The switchboard itself is of Ellis pink Tennessee marble, quarried so that all veining matches, furnished by the Evans Marble Co.

On the right hand of the doorway is the three-wire incandescent and power board, and to the right of this is the arc light board. The switchboard at the left of the door is for the railway service.

The different appliances for this board were designed for and purchased by the company, and the whole switchboard was assembled and erected by its employés, under the supervision of Messrs. Herrick and Burke.

Fig. 18 shows one dynamo railway board for a pair of dy-

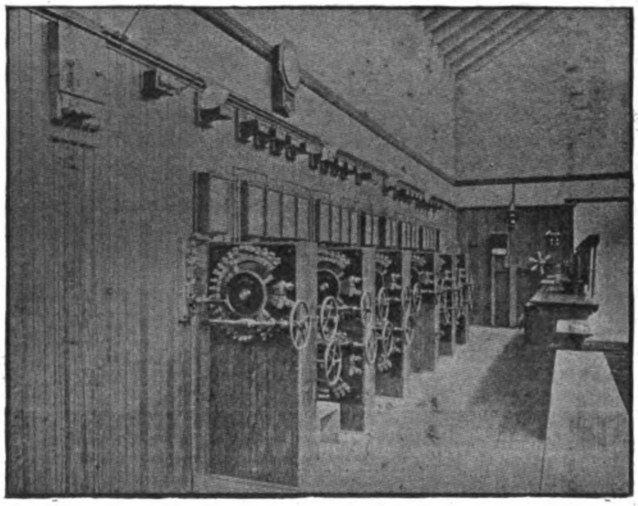


FIG. 21.—1888 INCANDESCENT SWITCHBOARD, PATERSON EDISON STATION.

namos. At the bottom of this board are the field switches which are double-pole and connected to a lamp bank, so that the fields are discharged through a lamp bank on withdrawing the switch. This switch also interlocks with the regulator so that it cannot be pulled out unless the regulator is at the lowest limit, and all the field regulating resistance is in series with the field and the voltage of the dynamos as low as possible. The regulator is of the quadrant type, on which there are four rows of staggered steps, and 80 changes of resistance are made in moving through 45 degrees, the current and potential rising as the regulator handle is raised.

The dynamo switches are of a recently designed snap switch type, and the positive, or the one leading to the trolley, is double throw, so that the system can be operated either at two potentials or two different railway companies can be operated independently of each other, if necessary. The negative switch is single throw and the equalizer is not brought to the switchboard.

Each dynamo is provided with a dynamo galvanometer, which is located on the dynamo regulator cover, with its pilot switch, which indicates which way the main dynamo switch is to be thrown when the dynamo potential is the same as bus, and each dynamo is independent of all others. The above appliances were designed by the electrical engineers for this plant, and were made by the General Incandescent Arc Light Company.

The amperemeters are of the Weston round dial type, having an oxidized copper finish, which is the finish of all the instruments and appliances on this board. Above the ammeters of

each dynamo is located a circuit breaker, which is of the General Electric Company's magnetic blow-out type. The current from these dynamos passes along the back of the board through bus bars, which are supported on marble insulators, and before it reaches the feeder board, the main negative current passes through a shunt, which gives the total ampere

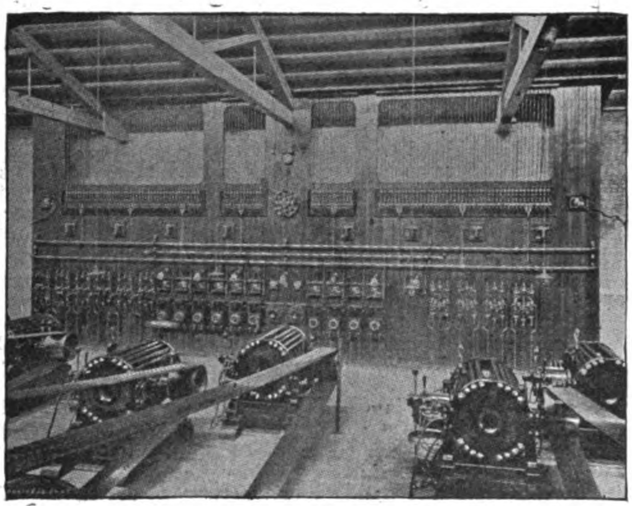


FIG. 22.—1888 ARC SWITCHBOARD, PATERSON EDISON STATION.

reading and also passes through a main 6,000 ampere snap switch, which controls sixty-three miles of road operated by this board. This current is carried off to the ground feeders and connections. The high and low positive both pass through Thomson recording wattmeters and are carried to the feeder board.

There are 82 feeders which cover a territory of 31 square miles, and operate different railroad systems, having a total of 120 cars in operation. Each pair of feeders, which feed into a continuous trolley section, is provided also with magnetic circuit breaker and double throw switch, so that its potential can be either raised or separated from the others in case of trouble. Fig. 19 shows this feeder board.

The incandescent three-wire board is located to the right of the stairway, and is of the same general design as the railway board, having the field switches at the bottom and quadrant regulators above these field switches. The two dynamo switches, the right being positive and the left being negative, are double throw of 2,000 amperes each, so that the machines can be thrown on either high or low potential, and above these are located the dynamo galvanometers and double pole galvanometer switch. Above these again are the edgewise dynamo ampere meters, the width of the panel being 16 inches.

FIG. 23.—SPACE OCCUPIED BY 400 H. P. IN OLD PATERSON EDISON STATION.

with a capacity of 400 kilowatt. The total output of this board is 1,000 kilowatt, or 6,660 amperes. The current is carried along the bus bars at the back of this board and passes through the pressure panel on which are located the main wattmeters, for high and low positive and negative buses, the main amperemeters, and the main voltmeters. It is also provided with a pressure switch by which the pressure of any feeder can be compared with the standard feeder. The current is then distributed to the feeder board and through edgewise ammeters to the distribution system. The arc light board is located on the extreme right and is provided for 32 feeders and 32 dynamos, and is of the well known Brush type. The ammeters are of the General Electric Company's new arc ammeter type; the voltmeter reads to 6,000 volts, and the pressure switch is of special design, built by the Ideal Electric Co. All feeders and circuits are carried out on the wall back of the switchboard through the cellar, under the floor of the office building, to the underground and overhead systems.

In furnishing power to the railway systems, it is very important to know what kind of service has been rendered, and for this purpose the instrument shown in Fig. 20 has been devised by Mr. Brock and constructed by Mr. M. E. Sanger, of New York, and which indicates when any feeder is open, also the length of time it was open, thus keeping an exact

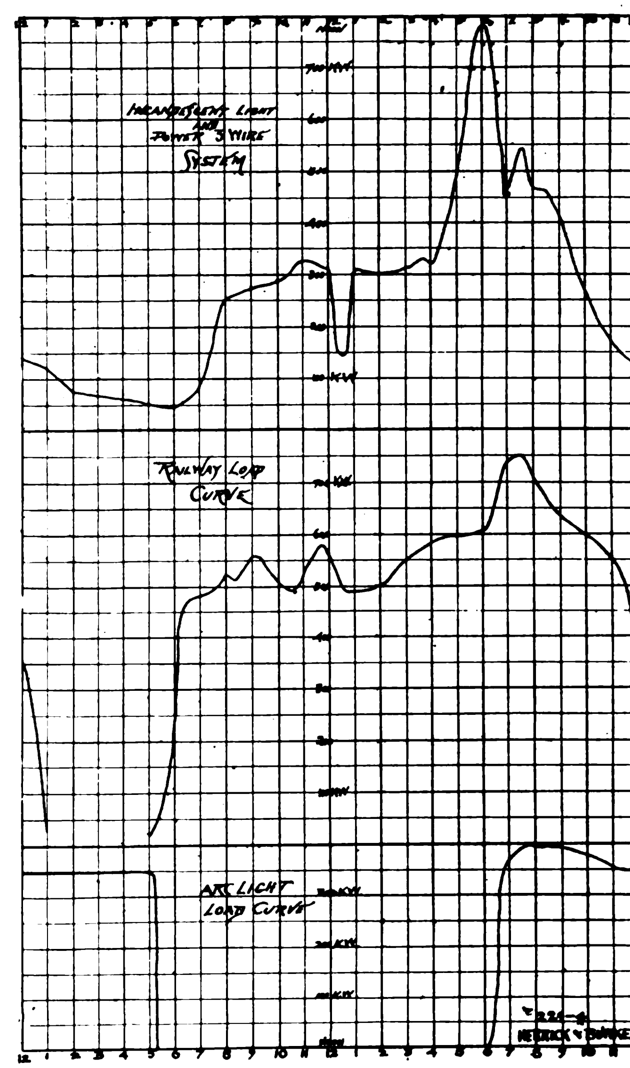


FIG. 24.—LOAD CURVES OF ARC, INCANDESCENT AND RAILWAY SERVICE.

record of the services rendered the railway companies, which is filed for reference.

In order to show the advance in switchboard work since 1888, illustrations of the two switchboards used in the old stations are shown in Figs. 21 and 22.

Another striking illustration of advance made in less than ten years is furnished by the illustration, Fig. 23, which shows four engines and dynamos required to do the work performed by one of the small units illustrated in Fig. 10.

THE ECONOMY EFFECTED.

This station took its load from the other two stations without a moment's interruption of any service, and the improvement in the coal item alone will be 2.8 pounds of coal per kilowatt hour, against 6.9 pounds of coal in the old incandescent station, and 4.3 pounds of coal in the old arc light station. One switchboard attendant can handle the three different systems, and by combining forces in the new station 45 per cent. of labor is saved in the current production. The output of the

three-wire plant can be increased to 25 per cent. with the same drop on feeders on account of the more favorable position of the new station.

The load curves of each of these systems is shown in Fig. 24, and the combined load curves are given in Fig. 25. The load factor for the total plant for October was 53 per cent., and it will be noticed how these three loads combine to bring the steam plant in condition for maximum all day efficiency.

There are a few feeders in the outlying districts which cannot be supplied at the proper potential from the high bus during the lighting hours. Two dynamos of 50 kilowatt each are connected to the quill of the arc light system, and these are run for these feeders. After 12 o'clock midnight the incandescent load falls off, so that these dynamos can carry the whole incandescent load, and the incandescent plant is shut down from midnight till morning hours, when the load commences to rise again.

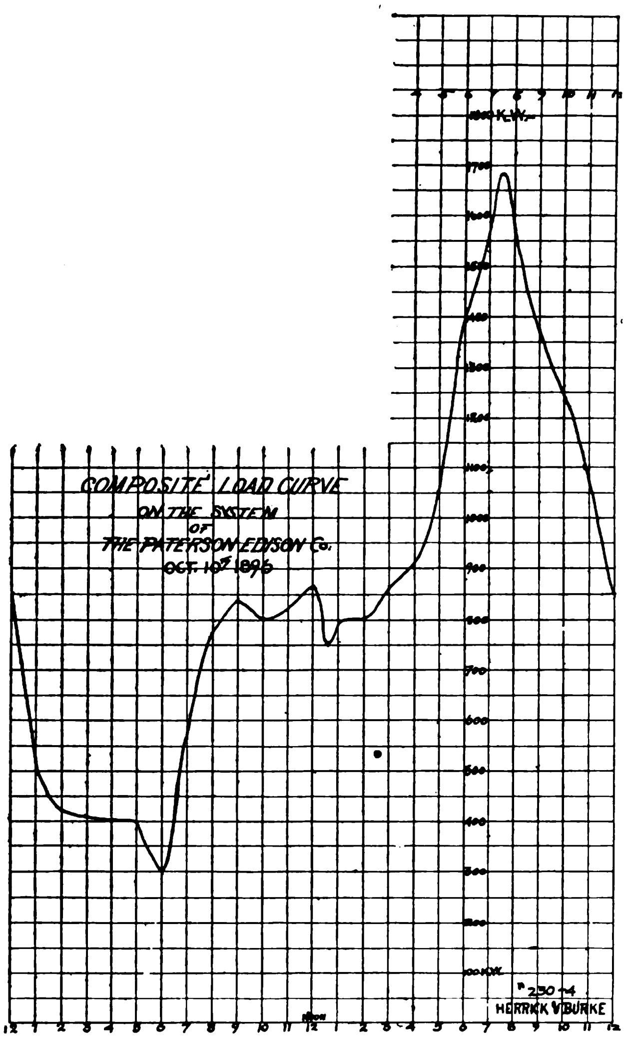


FIG. 25.—LOAD CURVE OF COMBINED SERVICES.

The load on this station is divided up as shown by the load curves. The method of charging for the current is by car miles for the railway, by the Edison chemical meter for the three-wire incandescent and power, and by contract for the arc light. The maximum load in kilowatts for October was 780 kilowatt incandescent, 750 kilowatt railway, and 400 kilowatt arc light, and as the population of Paterson is 100,000, this gives an output of 19 watts per capita.

The officers of the company are: William T. Ryle, president, and the financier of the company; William Strange, vice-president; Arthur Ryle, treasurer, and William M. Brock, secretary and general manager, to whom great credit is due for the conception and erection of this plant, assisted by Mr. J. W. Ferguson, builder and general contractor, and Messrs. Herrick and Burke, consulting and designing electrical engineers.

CICERO, ILL.—The town of Cicero, a suburb of Chicago, proposes to have an electric light plant of its own to illuminate Oak Park and the western part. Plans and specifications from four different companies estimate a cost of $25,000.

INTERCHANGEABLE ELECTRIC SIGNS.

BY THEODORE WATERS.

IT is a fact which must have forcibly struck every electrical man, that the use of electrical effects for advertising purposes, has become very much extended of late. But it may not be generally realized that the manufacture of special electrical advertising devices has grown until it has reached the dignity of a distinct department. It will be found upon investigation, however, that a number of firms have been organ-

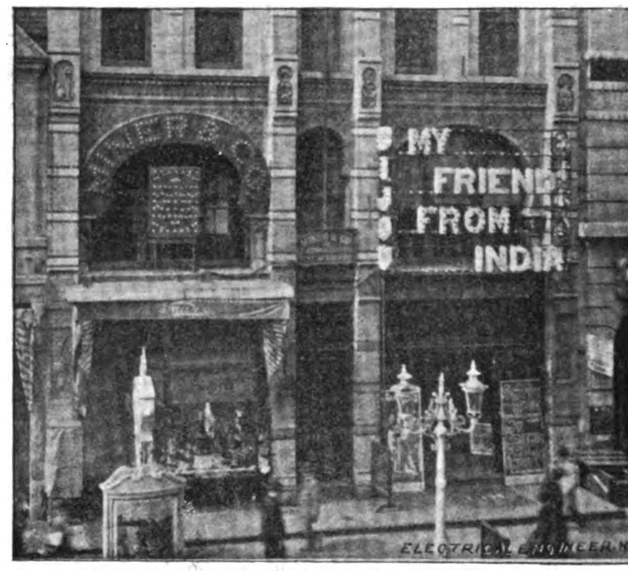


FIG. 1.—ILLUMINATED LETTER SIGNS.

ized with the definite purpose of manufacturing this class of goods. It is indeed a niche which must sooner or later have been filled, for nothing could more fully suit the requirements of the advertising agent than various combinations of electric lamps for the purpose of attracting and holding the attention of the all too fickle public. Upon the general background of night the most brilliant and bizarre effects have been obtained and it does not seem at the present time as though any other agent is soon likely to supersede the electric current in this direction.

The newest feature of the business is the number and variety of interchangeable signs now in use in various places. By

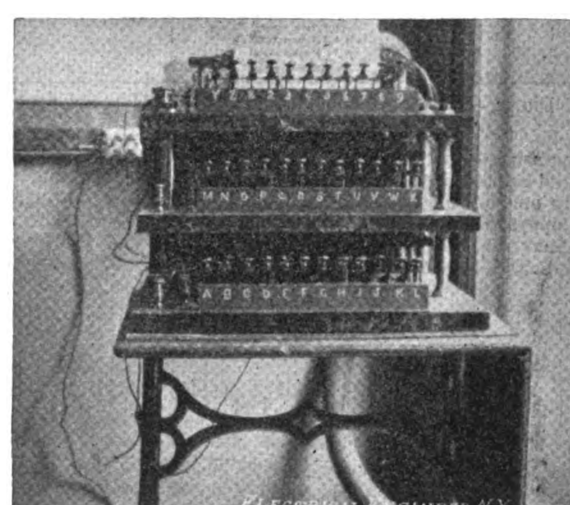


FIG. 2.—KEYBOARD FOR ILLUMINATED LETTER SIGN.

interchangeable signs are meant those devices on which the lettering may be changed at the will of an operator, so that names, mottoes, catch phrases, etc., may be spelled off for the delectation of the onlooker. Some of these devices are very ingenious in arrangement and construction and the var-

iety of their form is sufficiently great to warrant them being collected and described.

Interchangeable or movable letter signs may be divided into two groups. One group comprises those boards on which only

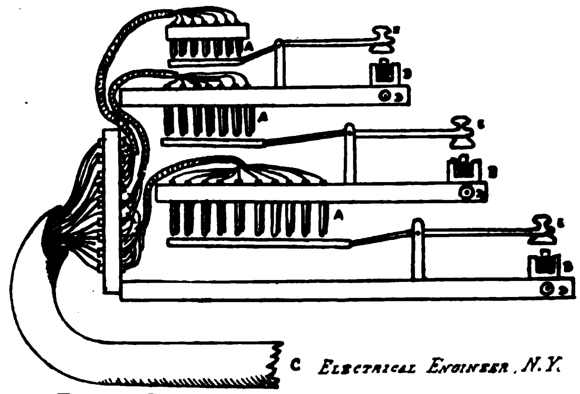


FIG. 3.—DIAGRAM OF KEYBOARD CONSTRUCTION.

one letter at a time can be shown. The other group includes those on which a whole word or sentence may be made visible. Each has its advantage from the advertiser's point of view. It is claimed for the one that the story is instantly told and no time is wasted; it is claimed for the other that the sense of

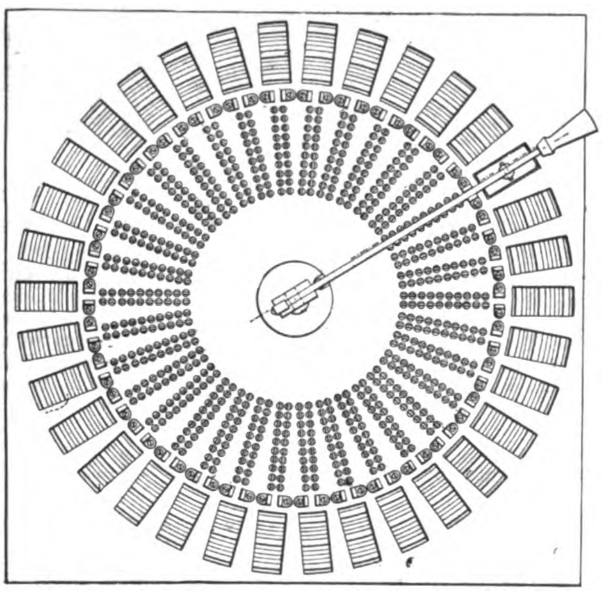


FIG. 4.—DIAL SWITCH FOR ILLUMINATED LETTER SIGNS.

expectancy engendered while the name or sentence is being spelled out adds to its advertising value. Of the single letter group one of the most interesting is now being manufactured and operated by Miner & Company, of New York City. It is the invention of Mr. Mortimer Norden. The lamps on the sign board are arranged as shown in the illustration, Fig.

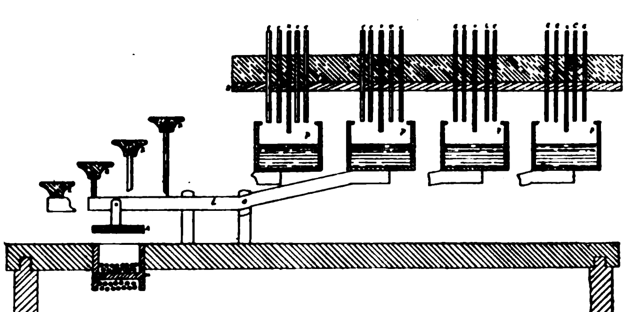


FIG. 5.—MERCURY SWITCH FOR ILLUMINATED LETTER SIGN.

1, on the board under the sign of Miner & Company. On inspection it will be found that any letter of the alphabet may be formed by lighting various combinations of these lamps.

The sign is operated from a machine very much like a typewriter in appearance, Fig. 2. It consists of a number of levers corresponding to the letters of the alphabet, which, when depressed at the front or button end make with the other end an electric connection between a number of clips, each pair of which corresponds to a lamp on the board. Every pair of clips forms the terminals of a circuit. The end of the lever coming between them bridges across the intervening gap. For instance, the wires attached to the lamps used in any one letter, are connected to a line of clips, A A A, in the rear of the operating machine, shown diagrammatically in Fig. 3. When the button, E E, marked with that letter, is depressed, the other end of the lever rises between the line of clips and every lamp necessary to the formation of the letters is thrown into circuit and lighted. The lever is held down by an electro-magnet, B B B, which is operated by the current. One lamp in series gives the proper current reduction for the magnet

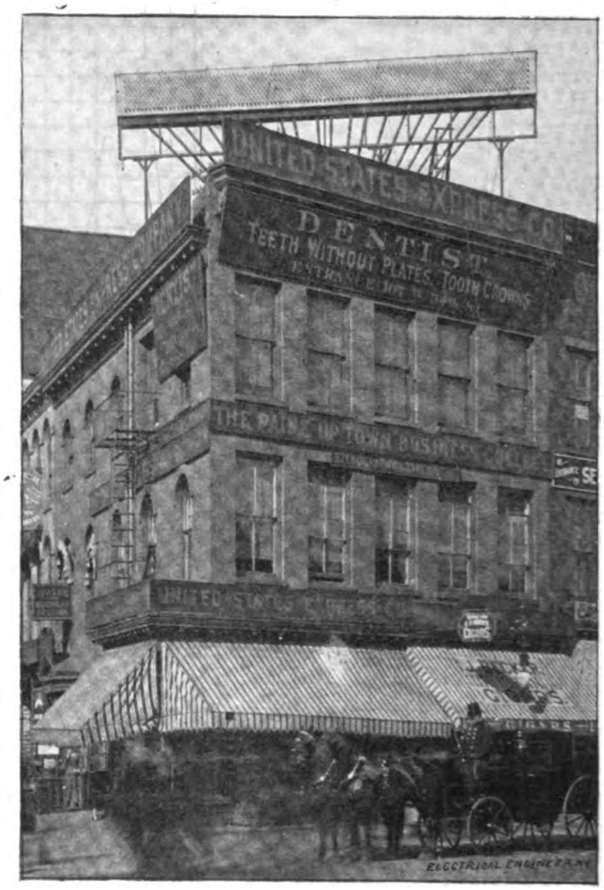


FIG. 6.—ILLUMINATED LETTER SIGN.

and the latter can be short circuited and the lever released by the simple pressure of a push button connection, D, arranged for the purpose, the lever being carried back to its original position by a spring. Naturally, some lamps on the board are used much more constantly than others in forming the letters, and much ingenuity and forethought was spent on the apparatus to so balance the wiring as to have it equal on both sides of the three wire circuit.

Messrs. Miner & Company believe in a board arranged with lamps as described, but they also operate several other entirely different machines for selecting the lamp letters. Another much more simple arrangement than the one just described is obtained when the clips attached to the lamp wires radiate from a center and are thrown into circuit by the simple shifting of a contact bar, as shown in Fig. 4. The latter would naturally carry the neutral leg in three wire systems. As many double clips or knife switches as there are lamps in a letter radiate from the center. As each pair of clips carries a wire from a lamp, it is obvious that when the knife bar, which can be turned to any point of the compass, passes between them, the letter formed by the lamps connected to any particular group will be lighted. As in the first machine, the bar once depressed is held in position by an electro magnet which thus keeps the desired lamp letter in circuit until short circuited by push button contact. The bar,

as in the first instance, is lifted from between the clips by a spring as soon as the magnetic action ceases.

The same firm is working on a mercury contact device which is intended to produce the same effect as accomplished by the above devices. Instead of making contact by a lever and clips, the end of every wire coming from the lamps is brought to and held in a position so that a mercury cup on being raised or depressed will make and break the circuit. The machine is in appearance like the one first described. The

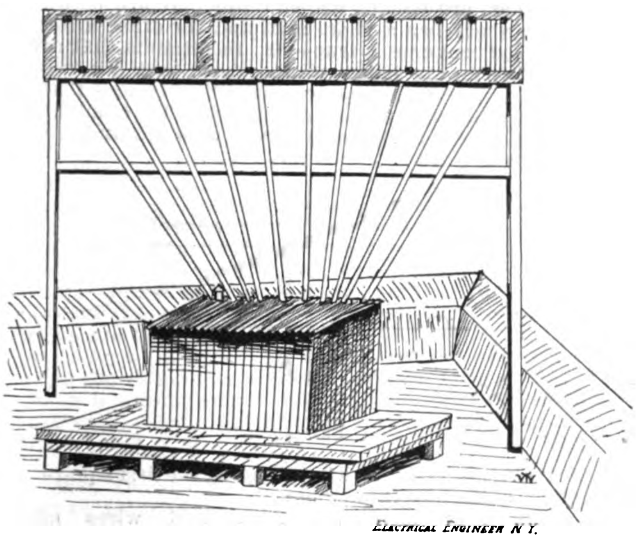


FIG. 7.—ILLUMINATED SIGN AND SWITCH CABIN ON ROOF.

ends of the wires coming from each combination letter on the board occupy a position pointing downward, Fig. 5. They are close together so that when the mercury cup, P, is raised on the end of a lever the points of the wires C C, are plunged into the mercury and a contact is at once made.

Still another device made by the firm consists of a series of metal tubes laid one inside of the other. The object of this is to do away with excessive wiring. There are as many tubes as there are lamps on the board. One wire runs from each tube to a corresponding lamp. A lever, as in the machine just described, operates between clips extending up from the tubes. Of course, only those tubes are included in a row of clips and consequently in circuit, as are needed for the lighting of each letter. This is the least complicated of all the devices thus far described.

Another single letter sign which has been operated by one

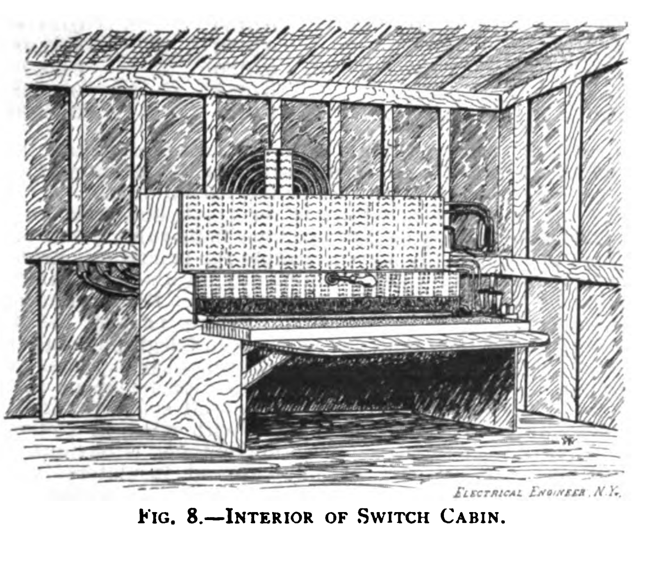


FIG. 8.—INTERIOR OF SWITCH CABIN.

of the New York daily papers is built on the typewriter principle. The contact is made differently, however. Instead of the opposite end of a lever rising between clips, the part directly under the depressing button makes contact with a piece of metal beneath it. But there is no magnet to hold it in position, and the great objection to it is its propensity for arcing. Its most unique feature is the arrangement of lamps on the board. The latter is, so to speak, a frame arranged in the form of a square, carrying its diameters and diagonals. The whole affair is covered with lamps arranged in the same manner as the frame. There is also an extra lamp at each corner to complete the design of some letters. Nearly every letter of the alphabet may be obtained on this sign. The contrivance is designed by Mr. Mason, of New York.

A typical example of the second class of interchangeable electric signs may now be seen in nightly operation on the roof of a building at Thirty-fourth street and Broadway, New York City. The sign, Fig. 6, as far as the public is concerned, is a solid oblong bank of lamps, out of which any letter, sentence or legend may shine at will. As a matter of fact there are 1,084 10-candle-power frosted lamps in the bank. The selecting apparatus is located in a frame structure built on the roof of the building under the sign, as shown in Fig. 7. The lamps on the sign are placed as close together as is possible without actually touching. The sign itself is located high above the roof and the cables are conducted up through heavy iron pipes.

The most interesting part, however, is the selecting apparatus. Its arrangement is unique. The operating table, Fig. 8, is made of slate. It lies flat and is bored full of quarter-inch holes. There are 1,084 of these; one for every lamp on the sign. The holes are half full of mercury, and each one connects by wire with a lamp. A three-wire circuit is used, the lamps naturally being evenly balanced between the positive and negative. The neutral leg is attached to a metal mercury trough which occupies a position along the edge of the board. The only thing necessary to complete the circuit is to connect the mercury in the holes with that in the trough. The letters are then formed in this simple manner.

The desired letters are marked out on a brass plate and brad nails are soldered on to it just far enough apart so that when the brass plate is inverted, the nails forming the letter will stick down into the proper holes. The brass plate is also made to connect with the mercury trough by means of an extra lug or hook soldered on to one end of the brass plate. Any letter or series of letters may thus be formed and the constantly changed sign is an object of such interest that it is nightly gazed at by crowds of people. Every lamp is properly protected by fuses, as are also the sections of the bank so that no unusual stress is possible. The sign and apparatus is owned by the Electric Sign Advertising Company, of New York. The work on it was done by the New York Electric Equipment Company. Power is supplied by the United Electric Light & Power Company.

TELEPHONY AND TELEGRAPHY.

THE TELEPHONE TRUNK LINE SYSTEM IN GREAT BRITAIN.—I.[1]

BY J. GAVEY.

THE author gave a brief history of long distance telephony, dwelling principally on the difficulties which were encountered. These consisted of : 1. Induced currents due to electromagnetic induction. 2. Induced currents due to electrostatic induction. The action of these disturbances was illustrated graphically.

The conditions which are necessary to obviate interference, due to the above causes, between two neighboring circuits, one of them at least being a metallic loop, are the following.

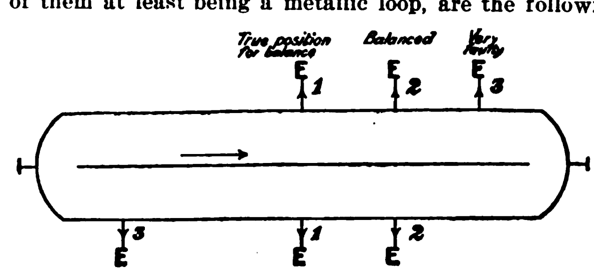


FIG. 1.

For practical purposes each circuit which has great length compared to its depth is considered to consist of two sides alone, the ends being negligible.

1. Each of the wires of one loop should maintain throughout the same or an average equal distance from each of the wires of all neighboring loops.

2. The two conductors of each loop should be of the same material.

3. They should have the same conductivity.

4. Each half of the circuit, including apparatus in direct circuit, should possess the same co-efficient of self-induction.

[1] Abstract of a paper read before the Institution of Electrical Engineers, London.

5. They should have similar electrostatic capacities.
6. They should have the same degree of insulation, whether high or low.
7. The resultant faults due to loss of insulation should be in the center of each wire of the loop; but if not there each should occupy similar positions at equal distances electrically from the extremities.

Conditions 1 to 5 are readily met, and, once attained, they are stable. No. 6 is more difficult to ensure, for the insulation of either arm of a loop may at any time be lowered by innumerable accidental causes, so that the most careful attention to maintenance is necessary to remove this source of trouble. No. 7 is at times a source of considerable difficulty, especially in the case of telephone trunks erected on poles carrying high-speed Wheatstone wires, when the latter are worked with shunted condensers. Thus, in Fig. 1, with the resultant earths at points 1, points 2, or at other symmetrical positions, the circuit is silent; but with positions 3 disturbance becomes evident, for the currents entering at these points traverse the telephones in establishing the electrostatic redistribution. Normally, the currents due to electromagnetic induction would be more considerable than those arising from electrostatic induction in a single-wire circuit with an earth return.

The methods of construction of telephone trunk lines differ but slightly from those adopted in the erection of ordinary telegraph lines, the principal difference arising from the necessity for providing the balanced circuits referred to above.

Taking, first, the simple case of two contiguous metallic circuits, if they be arranged so that the two arms of each loop are at diagonally opposite angles of a square (Fig. 2.), then the condition No. 1 is observed, and the circuits are balanced for distance whether the wires are run straight or whether they revolve; and in a similar manner a loop on a horizontal arm (Fig. 3) is balanced against a single wire on a saddle with an earth return, so long as the single wire is at the apex of an isosceles triangle of which the loop forms the base. With this exception, to obtain a balance between one loop and a second circuit external to it, whether metallic or with earth return, the wires of each loop must revolve uniformly the one round the other. In underground work this revolution is a uniform spiral, but with open work the wires simply change their positions regularly on each successive pole. In England the method adopted is almost uniform, and it consists in continuous changes of position, every wire being moved transversely at an angle of 90 degrees at each pole, so that a complete revolution is effected in every four spans. Other methods of crossing have been adopted on the Continent, but the above is perhaps the most simple way of achieving the end in view. In some cases the wires are run parallel, and crosses introduced at intervals to obtain an approximate balance.

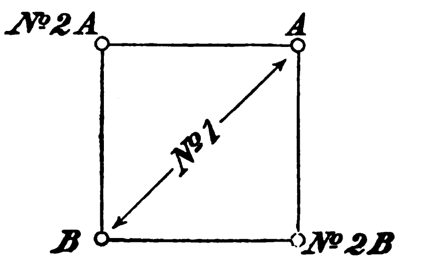


FIG. 2.

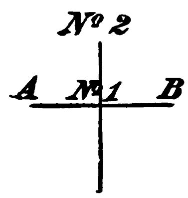


FIG. 3.

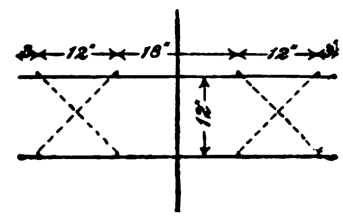


FIG. 4.

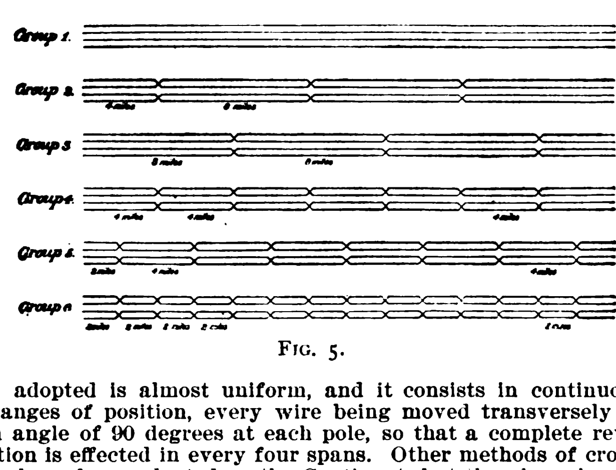


FIG. 5.

The present practice is to erect four wires on arms 48 inches long, divided as shown in Fig. 4, the arms being fixed on the poles 12 inches apart from center to center. Thus two arms provide space for four metallic circuits, the four wires on each side of the pole forming a section of a 12-inch square, the diagonal wires in these squares being taken up by each circuit.

Of course, as previously pointed out, the two diagonal circuits in one square are perfectly balanced against one another, and therefore free from mutual disturbance; but in dealing with a large number of telephone loops, if the relative average distance between each of the two wires of any one circuit, say, in the right-hand square and those of the two wires forming each circuit in the left-hand square be measured, it will be found, when all wires have the same twist, either right or left-handed, that the average distances between wires of the circuits, the diagonals of which are at right angles to one another, are equal., whilst those that are parallel are not. If one square has a right-hand and the other a left-hand twist, then the converse is true—viz., the circuits that are parallel at each pole are balanced and those that are traversed are not. It is found in practice that disturbances that arise between neighboring twisted circuits can be eliminated by crossing systematically. Thus, dealing with a number of circuits on one route, the four wires forming the first square may be revolved uniformly throughout.

The next four have the A and B wires of each circuit crossed eight miles from the starting point, and at intervals of eight miles onwards. The third group have the first cross four miles from the former point, then the remainder of the crosses succeed at intervals of eight miles. The wires of group 4 are crossed throughout at intervals of four miles. Those of group 5 have the first cross two miles from the terminals then the remainder of the crosses at four mile intervals. Group 6 is crossed at intervals of two miles. It will be observed, on examination of Fig. 5, which illustrates the arrangement, that each circuit is balanced against all the neighboring ones; and by this simple method it has been found possible to establish a series of wires absolutely free from overhearing.

The resistance and the inductive capacity of the various overground wires used in practice are as follows:

Lbs. per m.	Resistance. Stand. ohms.	Capacity to E.	Capacity, wire to wire.
100	8.782	0.0144	0.00864
150	5,·54	0.0147	0.00882
200	4,391	0.0150	0.00900
300	2.929	0.0153	0.00918
400	2.195	0.0156	0.00936
600	1.464	0.0158	0.00948
800	1.098	0.0160	0.00960

It will be observed that with the standard distances at which the wires of a loop are erected in this country the capacity, wire to wire, is 0.6 that of the wire to earth.

The use of underground wires for trunk lines was utterly impracticable so long as gutta-percha, india-rubber, and other kindred materials only were available for insulating purposes. The introduction of what is practically an air-space cable by the use of paper insulation appears to offer the solution of a difficulty looming in the immediate future, namely, the finding of space for the numerous wires, both telegraphic and telephonic, which will be required between busy centers. Unfortunately, the need for two wires for each telephone circuit results in the rapid filling up of all aerial supports; and the undesirability of overcrowding poles with wires in a climate like ours, subject to snowstorm interruptions, is obvious.

Hitherto, the capacity of underground insulators, which roughly equalled 0.3 of a microfarad per mile, seriously limited the use of subterranean conductors. The capacity to earth of paper cables has already been reduced to a figure varying from 0.06 to 0.08 microfarad per mile with small conductors weighing 20 pounds to 40 pounds per mile; and although these are not well adapted for long trunk circuits, their use for relatively short circuits will soon become general. For heavier conductors weighing 100 pounds or 150 pounds per mile, the capacity to earth is about 0.1 microfarad per mile. At the end of the year 1895 the mileage of telephone trunk wires in Great Britain and Ireland, actually complete or in course of completion, had reached the following figures:

	Miles.
Postoffice system	20,522
National Telephone Company's system	28,999
Giving a grand total of	49,521

Further and rapid growth may be confidently expected, so that the present mileage will soon be largely exceeded. Every great town in the country is, or will be, connected with the telephone trunk wires of the State; and it is probably not unsafe to predict that within the course of a few years practically the whole of the commercial business of the country will be transacted by telephone. In the neighboring manufacturing and commercial districts this condition of things has already been nearly attained.

The method of working the telephone trunk system of the country, with due regard to all the interests at stake, has been a matter of careful consideration on the part of the Postoffice Department in conjunction with the responsible officers of the Telephone Company.

The general system adopted is as follows: All the trunk circuits are terminated at the respective postoffices. Connection between the trunk and the local subscribers' switches is established by means of "junction circuits." For each trunk circuit one junction is provided to the local postoffice switch, and one to the company's principal exchange switch. These junctions are used solely for switching.

For conveying instructions, call or service circuits are established in the ratio of two circuits to each local switch for every 20 or less number of trunks. Half these circuits, known as "up" call circuits, connect the local switches with the recording tables, and they terminate in headgear telephones which are worn continuously by the ticket operators. The other half, known as "down" call circuits, serve to connect successive groups of 20 trunk jacks direct with the switches of the local subscribers, and they likewise terminate in headgear telephones.

At the smaller offices, where a few trunk circuits only exist and the traffic is but slight, the call wires are fitted with indicators, and at the larger offices the call wires are terminated on indicators during the slack periods, as it would obviously be absurd to retain an operator listening continuously for a few intermittent calls.

The method of working is, briefly, as follows: A demand for a trunk call is conveyed to the local switch operator; the latter at once, without initiatory ring or signal, transmits the request to the recording operator, who enters the particulars on a ticket, which is then timed in telegraphic code and sent to the trunk section affected. It may thus be said that a local subscriber's want is immediately made known to the trunk operator at the neighboring postoffice; although the actual time of putting through and the commencement of conversation depend, of course, on the number of prior calls, and the time lost in obtaining the distant subscriber's attention.

When the call matures—i. e., when the trunk circuit is free, or previous calls have been disposed of—the trunk operators at each extremity come in on the "down" call circuits, and request the junction operators to join specified junctions through to the subscribers who are wanted. This done, the trunk operators then ring up the subscribers, and on receiving replies they connect them direct to the trunk circuit.

HAWAII REFUSES AN AMERICAN CABLE FRANCHISE.

A special dispatch from Honolulu, of Nov. 17, says: A new contract has been proposed by the Pacific Cable Company, which organization includes such men as D. O. Mills, former Mayor Hewitt, of New York, and Mr. Hill, of the Great Northern Railway.

This company asks for a contract by which they are to have two years in which to obtain concessions from the Japanese Government and the Australian colonies relative to the laying of cables from Hawaii to Japan and from Hawaii to Australia. The company offers to purchase $375,000 of the new 4 per cent. Government bonds, presumably at par, and to forfeit $125,000 in case an inter-island cable is not laid within a year. If the desired concessions from either or both Japan and Australia are obtained within two years the company will forfeit $125,000 in each case if it fails to construct the cable within three years thereafter. On these lines they ask twenty years' exclusive franchise.

Acting Minister of Foreign Affairs W. O. Smith yesterday notified John W. Foster, attorney for Col. Z. S. Spalding, that after due and careful consideration on his request for an extension of concessions already granted to Colonel Spalding the Government has decided that it is not advisable at this time to extend any of the franchises or privileges he may now have regarding the laying of a cable from the United States to Hawaii so as to include an exclusive franchise for a cable line between Hawaii and Australia or Japan, or both. While the Government regretted that it was unable to comply with the request, the executive wished to express hopes for Colonel Spalding's success in building the line originally proposed between the United States and Hawaii.

THE TELEPHONE IN THE EDUCATION OF DEAF MUTES.

According to the experiments of Dr. Bertram Thornton, the telephone promises to be of material use in the education of those deaf mutes who possess a fragment of hearing power, and it has this advantage over the single speaking tube, that is sometimes used. In the first place, with it a teacher can instruct a group of children at the same time; secondly, it is not necessary for the teacher to apply his mouth close to the transmitter, the pupils have a full view of his features, expression and lip movements, which is not the case when he has to direct his attention and his voice into the mouth of the speaking tube or trumpet. It is well known that in most cases of deafness the actual hearing part of the apparatus, so to speak, is capable of performing its function, but the mechanism for collecting the sound waves and transmitting them to the cochlea and its appendages is defective. This is also the case in a large proportion of instances of deaf-mutism. In using the ordinary speaking tube, the voice of the speaker is increased in intensity to an almost painful degree, and the lips have to be placed close to the mouthpiece. By using the telephone an intensification of the voice at least equal to the most improved form of ear trumpet is obtained at a distance varying from 6 inches to 1 foot from the mouth of the transmitter. Dr. Thornton has found this fact an immense help in the teaching of deaf mutes. He mentions two cases in which the utility of the telephone was materially manifested. The first was that of a young woman with nerve deafness so extreme that it was necessary to speak at the top of one's voice within two or three inches of her ear to enable her to hear. With the telephone he was enabled to converse with her in a subdued voice, with his mouth twenty-six inches away from the transmitter. In this case she received some assistance from reading his lips, though she was only a beginner in the accomplishment. In another case, a man with a similar degree of deafness was able to hear his wife and another person conversing with him in tones raised hardly above a whisper, they being inside the room and he outside, with the door shut. The value of the telephone in deafness, it is claimed, is not yet half appreciated, and many progressive aurists are now devoting a good deal of time to the study of the subject.—Ex.

GOVERNMENT TELEGRAPH WIRES.

Gen. A. W. Greely, chief signal officer of the War Department, in his annual report says that interruption to telegraph communication has been so infrequent during the year as to be practically nil. The most frequent cause of interruption has been maliciousness, through a tendency of lawless individuals to pull down poles, cut wires or shoot off insulators. The speedy resumption of communication after such occurrences has been due to a great extent to the adoption of the bicycle as a means of transportation for repair men in place of the more expensive horse and wagon. The bicycle affords the more rapid as well as more economical method of travel. Frequently breaks in a line have been repaired by the use of the bicycle in less time than would have been consumed in obtaining a horse and vehicle. At some stations in a single year the original value of the bicycle has been saved to the Government.

LAYING SUBMARINE TELEPHONE CABLES AT TOLEDO, O.

The Central Union Telephone Cable has recently laid 900 feet of fifty pair submarine cable across the Maumee River, at Cherry street, Toledo, O., in two cables, each 450 feet long, under the direction of Mr. E. M. Jackson, superintendent of construction. This cable is made up of seven strands of No. 28 wire, American gauge, twisted together. Each of these stranded conductors is insulated .145 inch with okonite. Each pair of conductors is twisted in spirals 3 inches long laid up with jute and armored with No. 6 iron wire galvanized. The cable, which was made by the Okonite Company., Limited, is buried in the river bed, the laying being done by an expert diver. It is secured at each bank in such a manner that if at any time it is hooked and dragged by passing craft it will tear away from the terminal box, but will be recovered by means of the twisted wire stay rope.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—X.

BY LIEUT. B. A. FISKE, U. S. N.

THE ELECTRIC TELESCOPE SIGHT.

At 2,000 yards, a ship of twenty feet freeboard subtends a vertical angle of less than one-fifth of a degree. The distance at which a gun captain stands behind his sights may be said to be 120 inches from the front sight and 60 inches from the rear sight; so that this angle of 1-5 degree is represented on the front sight by about 2-5 of an inch, and on the rear sight by about 1-5 of an inch. Now, in order to shoot correctly, the gun captain must fire so that the projectile will leave the gun just when the exact points of the two sights are in line with the target. It is not very easy to do this, as the records of gun practice at sea most sorrowfully prove.

A little reflection will show why correct firing is so difficult. In the first place, the construction of the ordinary bar sights is such that, unless the sights are on a level with the target in a vertical plane, it is extremely difficult to tell if they are pointed in the proper direction in a horizontal plane; and not only this, but when the ship is rolling away from the target, the rear sight and the gun itself masks the target completely; in the second place, the line of sight sweeps over the entire vertical target in 1-5 of a second (supposing that the ship is rolling 1 deg. per second, which is very slowly), so that the gun captain has only one-fifth of a second of time in which to make up his mind whether the sights are on the target, and to fire if they are on the target. Now the three objects which he is trying to get into line are the target, the front sight and the rear sight, of which one is 2,000 yards distant, another about 10 feet, and the other about 5 feet; so that he is called upon instantly to focus his eye on three points at distances of 2,000 yards, 10 feet and 5 feet, and the human eye is so constructed as to make this impossible. But the formidable difficulty is that, during the one-fifth of a second in which the gun captain must do the things above enumerated, he must, in addition, have the pupil of his eye behind the rear sight in an exact line with the line prolonged from the front sight to the rear sight. If the pupil of his eye is not exactly on this line he cannot recognize the instant to fire, except approximately, and if his eye be as much as 2-5 of an inch above or below the line, and he fires when his front or his rear sight rests on the target, his gun will really be pointing 20 feet above or below the point of the target on which the sight rests. It is not an answer to point out the wonderfully fine shooting done by some men, because the records of target practice show that such shooting is, to say the least, exceptional. Now, a telescope of large field and small magnification has been found to practically eliminate all the errors of sighting, and to make it possible and easy for an ordinary man, with hardly any practice at all, to shoot fairly well always, and badly never, as was proved before an official board in the U. S. S. San Francisco, by the writer using in many cases absolutely untrained men, including firemen and coal heavers.

(Twenty-nine shots were fired, each shot counted either 5 or 4 (5 being the maximum). The deviation of the projectile to the right or left, as observed from the ship, was so small in each case that it could not be measured with any means at hand; it was therefore estimated, using the known dimensions of the target as reference. Sixteen out of the twenty men firing had never used the sight before. One man who made an average of 90 out of a possible 100 had never, so he stated, fired any kind of a gun, musket or pistol.)

The large clear field of view with the two cross-wires, one vertical and the other horizontal, lets a gun captain see (even when the horizontal wire is far below or above the target) just how much the gun must be moved to the right or left; everything is exactly in focus, so that there is no strain on the eye whatever, and (which is the most important), the gun captain cannot sight wrong even if he tries. He cannot take a fine sight, or a coarse sight, or a bad sight. The cross-hairs are either plainly on the target, or plainly not on the target; and just so long as he looks through the telescope at all, he can see the cross-hairs in only one place, and that is in the fixed axis of collimation of the telescope. Since a telescope can be made to endure about as much rough usage as a football, it is surprising that any sights except telescope sights are used in modern ships. Of course they cannot be used on the guns themselves, because the guns recoil, but they can be placed on some non-recoiling part of the gun-support laterally moveable with the gun. The latest form of telescope sight has a field of view of 19 deg. in each direction, with a magnification of about two diameters, and is so strong as to be less liable to injury in service than is the ordinary long bar sight; so it can be kept in place all the time, ready for instant use. In order "to make assurance doubly sure," a strong sheet-iron cover thoroughly japanned is arranged to cover the sight when it is not in use.

A ship which can adjust her gun sights quickly, when the range is changing quickly, will have a great tactical advantage over a ship which cannot. It has been found, in practice, when the range is changing rapidly, that the range finder and range indicator can measure and signal ranges so rapidly that it is impossible to set the sights and get ready to fire before a new range necessitates a new adjustment of the sight.

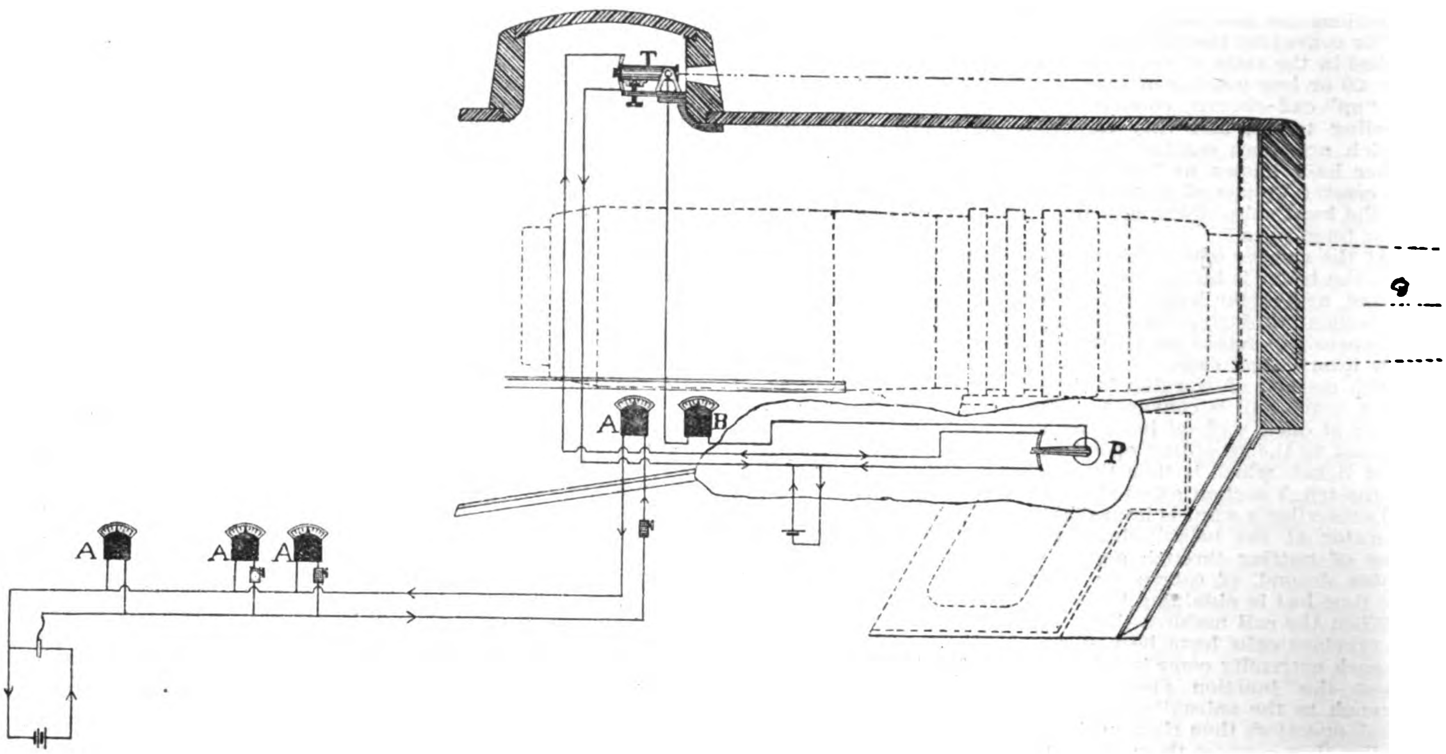


FIG. 34.

To secure the tactical advantage to be obtained by meeting this difficulty, the electric telescope sight has been devised to so work in co-operation with the range indicator, that the setting of the sight occupies but an instant, and does not interfere with the firing of the gun, or distract the attention of the gun captain.

As shown in Fig. 34, one of the receivers of the range indicator circuit is placed alongside of a similar indicator, which shows the distance corresponding to the angle between the bore of the gun and the line of sight of the telescope, placed in the sighting hood above the gun. Evidently the telescope and the guns are converged at the correct angle when the indicators indicate the same distance.

The operation is as follows: The gun-firer places his telescope at whatever position in the vertical plane he finds convenient. He does not need to know the range, except approximately.

The elevator man watches both the range indicator and the gun elevation indicator, and merely works the elevating mechanism so as to make the latter read the same as the former.

When the gun-firer sees his cross-hairs rest on the target, he presses the electric firing button.

To prevent his firing when the indicators indicate differently, the firing circuit is broken at two places—one place being his firing key and the other place being a similar key near the elevator man. The gun cannot be fired unless both the elevator man and the gun-firer press their keys; and neither presses his key unless he is ready. The elevator man keeps pressing his key so long as the two indicators indicate the same thing; but, if the range suddenly changes, he releases his pressure on the key until by moving the elevator wheel he has made the gun elevation indicator indicate the correct distance; he does the same thing, if the gun-firer changes the position of his telescope and the indication of the gun elevation indicator. It will be noticed that this operation on the part of the elevator man is a very simple one, since he merely has to move his wheel a fraction of a revolution in one way or the other, to keep the needle of his indicator at the same mark as the needle of the range indicator beside it.

On the base of the telescope sight are arrangements for correcting for speed and drift. The electric sight has not yet been tested in service, but it is merely a combination of the

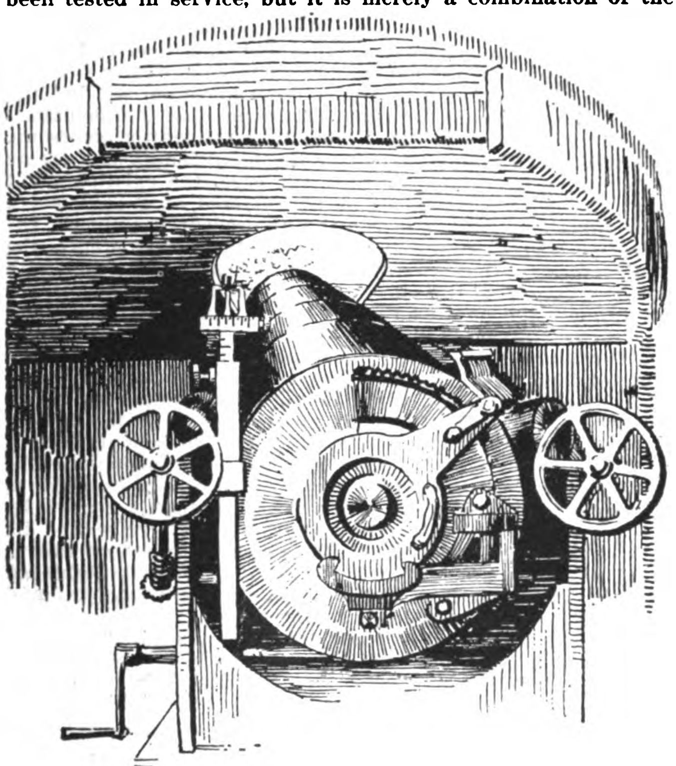


FIG. 35.—A BATTLE-SHIP 300 FEET LONG, MASTS 150 FEET HIGH, SEEN OVER ORDINARY GUN SIGHT AND THROUGH PORT IN GUN SHIELD.

Horizontal field in gun port = 9.5°. Vertical field = 3°. Eye of gun captain being 60 inches behind rear sight. Ship is 2,000 yards distant.

mechanical telescope sight with a simplified form of the helm indicator and steering telegraph.

In the case of guns that recoil along the line of fire, especially with the smaller calibers, the telescope sight is attached directly to the support of the gun, which moves laterally and vertically with the gun, but does not recoil.

Fig. 36 shows the field of view of the telescope sight which the writer mounted on the support of a rapid-fire gun on board the Yorktown in 1892, and afterwards in the U. S. S. San

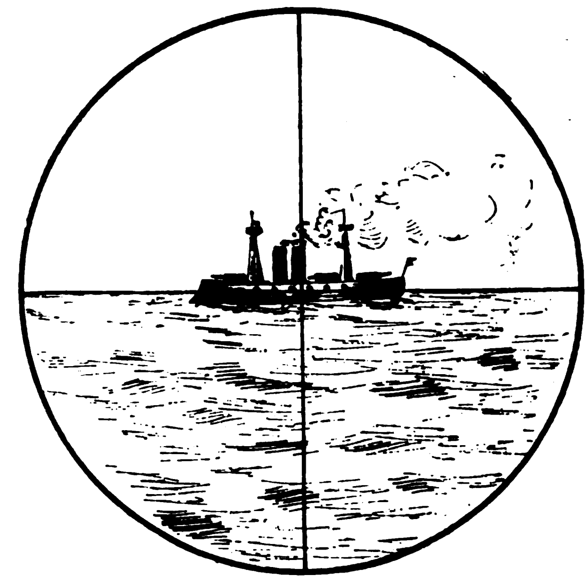


FIG. 36.—SAME SHIP SEEN AT SAME DISTANCE, THROUGH TELESCOPIC GUN SIGHT.

Horizontal Field = 8°. Vertical Field 8° = magnification, 4 diameters.

Francisco in 1893 and 1894, the gun being frequently fired in both ships to test the sight. Fig. 35 shows, in comparison and on the same scale, the field of view obtained looking through the port in the gun shield, when using the ordinary sights on a 6-inch gun, in the Yorktown, on the shield of which the sight was tested.

LITERATURE.

AMERICAN TELEGRAPHY; Systems, Apparatus, Operation. Second Edition.—By W. Maver, Jr., New York. Wm. Maver & Co. Cloth. 450 illus. 564 pages. Price, $3.50

We are glad to see this valuable and useful book reach its second edition, and to know that the sales continue steadily large. It is not merely a reprint in this case, but the matter has been revised and added to, there being about 7,000 words of additional matter and 11 new cuts. Among the new things and topics introduced are the storage battery in telegraphy; new repeaters; the Morris duplex with battery at one end; Burry self-winding stock transmitter; motor transformers for furnishing current; new W. U. standard quad; new polarized and neutral relay, etc. As usual, everything is done carefully and thoroughly, and the book remains one on which the author can safely stake his reputation as a consummate master of the theory and art of telegraphy. It is a book without which no electrical library is complete, a book that every ambitious and conscientious telegrapher should know intimately from one cover to the other. Various improvements have been made in the general get-up of the book which is a handsome, well printed volume.

OUR NEW PRESIDENT, MARCH.—By Juliet S. Norton, Union Mutual Music Co., New York.

Miss Norton's new march has the ring of victory. The word "triumphal' has been purposely omitted, it is evident, as the music tells its own story. The leading theme is pleasing and characteristic, and is agreeably relieved by a variant in the bass with a treble accompaniment, working up to an excellent close. The march should be popular.

MARRIED.

MR. F. S. PALMER, general manager of the Electric Heat Alarm Company, of Boston, was married on Nov. 30, to Miss Nellie Lauretta Schultz, of North Cambridge, Mass., and will be at home, 56 Frost street, North Cambridge, on Wednesdays after December 9. Mr. Palmer is well known in the East and has received congratulations from hosts of friends, who all wish him well.

THE

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[INCORPORATED.]

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CONTENTS.

THE CAPITALIZED VALUE OF INTELLECT IN INDUSTRIES.

IT is said, and probably with truth, that there never was a time when intellect enjoyed a larger share of the increment of wealth, in the shape of profits and salaries than at the present time. Ability to manage and direct is paid for at a high rate, and the services of men of executive talent are actively in demand. The tendency of the times toward the massing of capital and enterprises is the reason for this, and the economy resulting from skillful direction explains also the increase in the reward of labor, either directly or by the shortening of the working hours.

Yet when the creative and organizing faculty is reduced to a basis of capital, there is often an outcry, and to-day much of the agitation against the "watering of stock" is aimed at the share which goes to the far-sighted planner of the enterprise, who not only saw the new opportunities, but seized them and made them yield profit not only to individuals, but to the world at large. This is the trouble with so much of the current socialism; it acts as a discouragement to genius and would deprive inventor, writer, organizer and artist of his part in the returns from new work. We are glad to find this aspect of a social problem dealt with clearly and ably by Mr. T. C. Frenyear, a gentleman well known in electrical engineering circles, who has contributed to the last number of the "Annals of the American Academy of Political and Social Science," an excellent article on "The Ethics of Stock Watering." His main, and incontestable, proposition is that the value of contributions to an undertaking not in tangible property or cash, should be generally recognized by capitalists, by the public and in legislation.

Incidentally, there is suggested to us by Mr. Frenyear's thoughtful article one reason why newspapers, lay and technical, are almost invariably, to a greater or less degree, on what may be called the anti-monopoly side of great questions. The technical press, for example, is constantly required by duty to build up new industries in its field, but it must always be averse, by the very nature of things, to a state of affairs which would assign to a few persons all the profits of that industry when built up and would thus tend to bar out the press from the natural rewards of its own efforts.

Turning to another aspect of a large question, we find the flaw in the argument for much of the proposed municipalization of various enterprises. Every time the matter comes up, it is said that the government or the municipality can create such and such a plant for so much, ergo, the existing plant must go out of business or be surrendered at a bald, sheer cash valuation. But what of the antecedent brainwork, the invention necessary to call new apparatus into existence, the local enterprise and energy that furnishes a given spot with the new facilities, the energy and organization that reaches out to meet the new wants and new demands of larger and larger areas of supply? These are surely entitled to some recognition and reward. But if one accepts the views of a nationalist like "Prof." Frank Parsons, of Boston, as enunciated again by him last week, when the municipality does not crowd out private enterprise, it is only to tax it down to the last degree of endurance on its actual cash value. The benefits derived by Boston to-day from its rapid transit system, inadequate like the systems of every other large city, are simply tremendous when compared with the relatively small profits reaped by the West End system by its remarkable enterprise and its huge expenditure. The clamor for a two or three-cent fare is based on the same short-sighted idea that all an enlightened city should permit is a pittance for courageous capital and nothing for exceptional brain power.

We cannot but agree with Mr. Frenyear that the "unearned increment" is often that which is most truly earned. It does not belong to the public necessarily, nor does it by any means always reach its rightful owners; but when the civilized world

gets through with rewards to its pioneering spirits, there will be no more increments at all for anybody.

THE PATERSON CENTRAL STATION.

AMERICAN central station engineering has, until recently, scarcely been a credit to the profession, but many of its shortcomings are unquestionably the relics of a pioneer period and to that extent ought not to be too harshly criticised. The large companies in the cities of the first magnitude, such as New York, Boston, Chicago, and a few others, were the first to inaugurate a more scientific era of central station construction, and their example is now being rapidly followed by companies in other places of lesser size. Prominent among these is the Edison Illuminating Company, of Paterson, N. J., whose station we describe in detail elsewhere in this issue. It is indeed a matter for congratulation to find an electric plant of this nature designed with the fixed purpose of equipping it only with the best and most advanced apparatus which the art affords, in regard both to the electrical and to the steam equipment. What lends additional interest to the Paterson station is the fact that it is a composite station, in so far as it supplies current for incandescent and arc series lighting as well as electric railway current. The economies possible in a station of this type must be apparent. We believe that more of these plants will be installed in the near future, or rather that the older plants which have outlived their usefulness will be "scrapped" to make way for modern high duty apparatus.

Much credit is due to Mr. W. M. Brock, of the Paterson Co., for the manner in which he has added to the models in central station plants of which there are but too few for the good of the industry. Mr. Brock has had the courage of his conviction that Paterson could support a first-class station just as well as New York or Chicago could.

TRANSMITTING POWER TO CITIES.

ONE of the most striking of modern developments in electricity is the manner in which adjacent water powers are being annexed by large cities. The recent transmission of power from Niagara to Buffalo is but one episode in a great development which hardly yet attracts the attention that it deserves. Instances already become numerous, but if the work goes on at the present rate, power transmission plants will soon be among the commonplaces of electrical enterprise. What is more particularly noticeable is that distances of 20 or 30 miles no longer count, at least in this country. Perhaps the best instance in Europe is still the 19-mile transmission from the Falls of Tivoli to Rome, but here examples of that magnitude multiply. The American cities that have absorbed distant water powers just as they absorb suburbs are by no means few. Buffalo has reached out electrically 22 miles to Niagara; Fresno, 35 miles to the San Joaquin River; Portland, 14 miles to the Willamette; San Bernardino, 29 miles to the San Antonio Mountains; Hartford, a dozen miles to the Farmington River; Salt Lake City, a good ten miles to the Big Cottonwood Canyon and the Wahsatch Lakes; Sacramento, more than 22 miles to Folsom. Supplementary to these come the installations now operating, or in process of construction, at cities such as Austin, Tex.; Riverside, Cal.; Springfield, Mass., and Minneapolis, Minn.

So far all this work has depended on the utilization of water power, but it is not unlikely that in the near future we may see the energy of coal transformed at the pit's mouth in the same way, and sent a long distance over aerial wires instead of in cruder form over iron tracks. There does not seem to be any specially good reason why Pittsburg should burn coal and remain dirty, when the coal might just as well be burned somewhere else, oustide the city limits; for if it were not cheaper to resort to electricity, it might pay to get out the gas and pipe that. People do not use any milk or cheese or butter the less nowadays because the cows are kept in the country.

ADVANCE OF ELECTRIC TRACTION.

AS we go to press this week two important items of news reach us as to further gains in behalf of electric traction. One is to the effect that the New York, New Haven and Hartford is to equip at once some of its short lines in the vicinity of Hartford with the third rail system, to be running in the spring; and that a power-house is to be built at Berlin for the work. Another item of equal importance is that the Metropolitan Company of New York is to equip its Fourth and Madison, Sixth avenue and Eighth avenue lines all with the underground trolley system, on the model of the Lenox avenue line. As was to be expected, the compressed air system has been tried and found wanting again for the purposes of city street traction; and it would appear that while the Metropolitan is satisfied with the cable on Broadway it does not want any more of it.

THE CONSISTENCY OF A CAPTIOUS CRITIC.

WE append two items, both taken from the same issue of the London "Electrical Review," a very nice little paper when not suffering from the mental dyspepsia which in the present instance, prevented its right foot from knowing what its left hand was doing. The paper for which the "Engineer" is jumped on so savagely was that read by Mr. McCulloch before the Am. Street Ry. Assn., and printed by at least a dozen technical journals. As will be seen, the London "Review" itself praises the paper in one place although pouring green bile over it in another. We trust our contemporary will soon be convalescent, clear-headed, and able to spell correctly:

"Our contemporary, The Electrical Engineer, of New York, does not pose as a comic paper, but none the less it succeeds in producing matter eminently entertaining to the average Britisher. In the issue of November 4 two columns were devoted to the discussion of steam power plant under the above exceedingly suggestive title (Steam Consuming Apparatus). A few months ago American lighting and power stations were considered as national asylums for the makers and sellers of leather belting, and not by any means the least instructive part of the said article is that which trots out the direct coupled plant as a modern development of American practice, whereas, notwithstanding that Edison long ago produced direct coupled plants, it was on this side of the water that the advantages of direct coupling were first fully explained and insisted on. The result is that probably neither here nor on the Continent could a single editor be found who would devote even so much as a single paragraph to the discussion of such an antidiluvian (sic) subject." Page 655.

"Few things could possibly better illustrate the difference between 'street railway' (i. e., tramway) enterprises in the United States and in this country, than the reports of meetings held by the respective tramway associations. Here, the Tramways Institute hears papers upon, and desultory discussions concerning, car starters of the coiled spring variety, new ideas in horse-shoes, or the best kind of winter food—varied by occasional references to gas motors or complicated conduit systems: over in the States they discuss matters dealing entirely with mechanical systems—and a typical bill of fare is that just gone through by the American Street Railway Association at their annual meeting, held this year at St. Louis. The subjects dealt with include such questions as 'Tracks and Track Joints: Construction, Maintenance and Bonding;' 'Trucks;' 'How to Increase Revenue by Transfers, etc.;' 'Modern Overhead Construction;' 'The Modern Power House;' 'Selection and Management of Employés,' etc., all of these being topics of a live and interesting nature." Page 666.

The "antidiluvian" matter referred to on page 655 was part of the "Modern Power House" paper, and is here properly mentioned as "live and interesting," on page 666. It is difficult, of course, to please both Dr. Jekyll and Mr. Hyde.

Electric Transportation.

MOTOR CARS ON THE BROOKLYN BRIDGE.

THE trains on the Brooklyn Bridge are now entirely operated by electricity, and the noisy, puffing, little steam locomotives in use since the first train was hauled across the Bridge have been at last discarded. The change was effected on November 30, when twelve motor cars were put into service operating the trains in conjunction with the cables more quickly, quietly and more satisfactorily than the steam motors. Fourteen motor cars are now in service, and the remaining six car equipments are being installed as rapidly as possible, to be put into service as soon as completed.

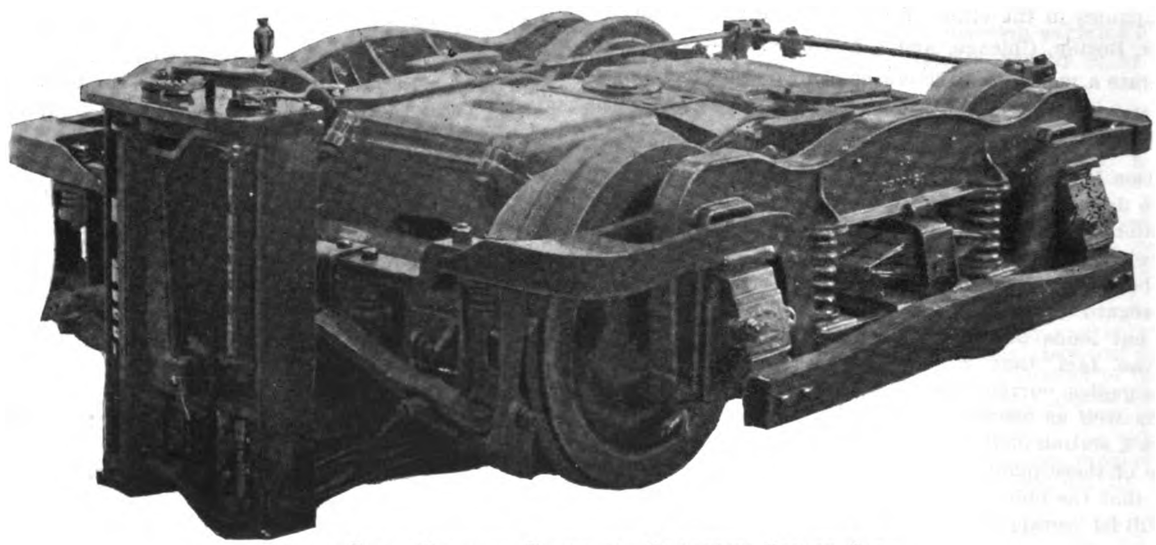


Fig. 1.—Fully Equipped Truck for Brooklyn Bridge Cars.

The motor cars do not differ outwardly from the regular passenger cars, except that the platforms are three inches longer. The length of the car is forty-five feet over all, and it weighs about twelve tons more than the ordinary car. The total weight with the motors is about thirty tons.

The trucks are from the shops of the McGuire Manufacturing Company of Chicago, and have been especially designed for this work. In these trucks the draft of the train is taken directly on the journal boxes, instead of through a swinging bolster, the entire top frame having a sufficient lateral motion to cushion on curves. The top frame is held in a central position in relation to the wheels by a novel double rocker connection between the trucks and the elliptical springs, part of the strength of these being utilized to cushion the side motion of the truck on curves, and return it to its normal position on the straight track. The weight of each truck is 10,000 pounds, wheel base 5 feet 6 inches, or 6 inches less than any other truck made for this purpose to accommodate two motors of the capacity of those used in this equipment. This is obtained by omitting the swinging bolster and substituting a better equivalent.

The general character of the electrical equipment is similar to that in use on the Metropolitan West Side and Lake Street Elevated Electric Railroads in Chicago, and on the electrically operated divisions of the New York, New Haven & Hartford Railroad. The equipment of each motor car consists of four G. E. 50 motors and two K. 14 series parallel controllers—motors and controllers also both especially designed to meet the peculiar requirements of the Bridge traffic. The motors have the usual characteristics of all General Electric railway motors. They are fully protected against the entrance of either dust or water, and for their power are extremely light, weighing each about 3,500 pounds. The armatures are of the slotted core type, each winding lying in its own slot. The

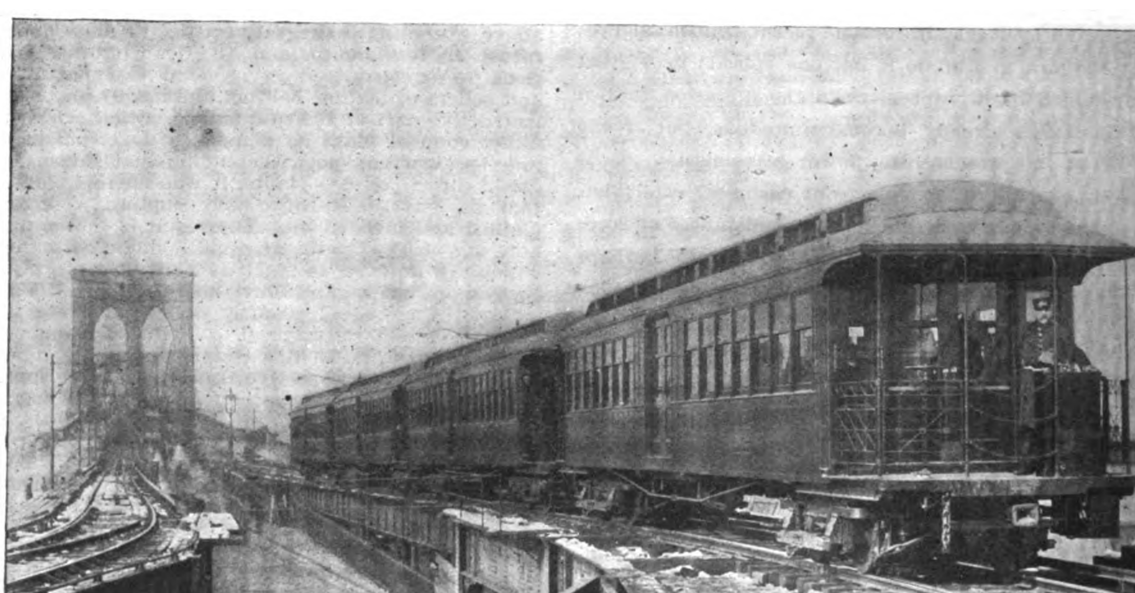


Fig. 2.—Motor Car Pushing Train Over Tilting Sheaves at the Brooklyn Terminal.

method of winding adopted allows of the removal and replacement of any of the armature coils with little or no disturbance of the others, while the crossing of two wires of large difference of potential is avoided. The motors are spring suspended, and the two forward ones are provided with a small roller at the front, upon which the cable can run and thus prevent injury to cable and motor. The illustration shows one truck of a motor car with a controller, and gives a fair idea of the compactness of the equipment. Each motor car has each track similarly equipped.

The series parallel controllers embody the magnetic blow-out principle, and in their operation, when the current is shut off, resistance is first introduced and the potential at the motor reduced before the circuit is broken. This avoids any strain on the motors due to sudden rupture of the current. When the circuit is broken the arc is immediately blown out, and the contacts do not suffer, the blow-out serving to chill the arc by spreading it over the surface of the breaking points instead of confining the root of the arc to its point of origin and consuming it.

The total number of notches is thirteen, six of the resistance points being in series and five in parallel. The reversing switch is, of course, arranged for four motors. The handle is interlocking and cannot be moved unless the controller handle points to the off position. The controller stands 46¾ inches high, 22¾ inches wide, and 10 inches broad, and is secured to the ironwork and floor of the platform. The resistances suspended beneath the cars are twelve in number. They are of the packed ribbon type set in open iron boxes.

Beneath each platform is an automatic circuit breaker, which effectually prevents any injury to the motors from a sudden rush of current. The breaker is set at 800 amperes, and should the current exceed this a latch is tripped by the action of a solenoid, and the contacts in the device are instantly separated, breaking the circuit. Additional protection is provided by cut-outs also embodying the magnetic blow-out principle, whereby the arc formed at the disruption of the fuse is magnetically extinguished.

The circuit breakers take the place of the well-known main circuit hood switches, and are wired in multiple instead of in series. In the experimental car to guard against any possibility of one being closed while the motorman was at the other end of the car and desired to open the main circuit, only one handle was provided. This handle could not be removed from the circuit breaker without breaking the main contacts, and when removed the circuit was locked open. In the new equipment no danger would ensue if both were thrown in, as the effect is simply to make the trolley connection alive on the controller, but the controller being open no current flows. In this respect the new equipment is superior to that used on the experimental car.

The current is taken from a third rail, in a manner similar to that used on the electric elevated roads in Chicago. This third rail runs on the outside of the service track and parallel with it across the Bridge and at all crossings and switches about one foot from the outside rail. The third rail used is the ordinary T-rail, bonded with No. 0000 bonds. They are laid on insulators, one of which is set at every fifth tie. These insulators are square, pyramidical pieces of vitrified clay, with a single petticoat, and are supported on iron pins fastened to the tie. The top of the pyramid carries two jaws, which grip the foot of the third rail and are screwed up by means of a bolt and nut. For the return the service rails are also bonded with No. 0 bonds. Between the journal boxes of each truck and on each side of it is an oak beam, from the center of which depends one of the contact shoes. These shoes are slung loosely from the jointed and slotted hangers, and have an easy up and down motion, as well as the ability to take any angle within a wide range, follow the surface of the rail at all times and make perfect contact. The shoes are of cast iron, about 12 inches long by 10 inches wide and ½ inch thick. Each weighs about ten pounds, and is wide enough to slide over all breaks on the third rail at all switches and crossings, and one shoe is always in contact. An insulated flexible cable connects the shoe to the motor.

The electrically equipped cars are known as the motor cars, and one is allotted to each train, forming part of it and carrying its share of the passengers. Its function is similar to that performed by the switching locomotives. The train empties at the terminal, the motor car draws or pushes it from the incoming platform to the tail track, and thence to the outgoing platform. It then moves the train over the tilting sheaves so that the grips on the other three cars may seize the cable, when the current is shut off and the cable performs its ordinary functions.

Under the conditions of the contract, the power of the four motors must be sufficient to propel the fully loaded train, weighing 120 tons, across the Bridge at the speed of the cable, 11.3 miles an hour, in case of breakdown of the cable. With the motors, the heaviest Bridge trains are readily hauled up the 3.78 per cent. grade, and so far as they are concerned, comply fully with the conditions. During the early morning hours the motor cars will handle the entire traffic of the Bridge after the cable has stopped running.

The motors will also help heavily loaded trains up the grades and keep the grips from slipping the cable. The substitution of the motor car eliminates one set of grips while adding twelve tons to the weight, and these grips are not always sufficient to handle trains which may be heavily loaded. As soon as the second set of tracks is ready and the additional cable running, it is expected that the headway will be reduced from 90 to 45 seconds.

The power to run the trains is taken from the Fulton street feeder from the Kent Avenue Station of the Brooklyn City Railway, the return wire being connected to the rails of the surface road.

The efficiency of the electric system under emergency was tested on the evening of December 2, 1896, when the operation was accidentally suspended. The rush homeward from New York to Brooklyn had already set in, and the entire operation of the Bridge for some half hour was thrown upon the motor cars. According to the Bridge authorities, the traffic was carried on without any appreciable loss of headway.

Roentgen Rays.

EXAMINATION OF CATHODE AND ROENTGEN RAYS THROUGH COLORED SCREENS BY THE FLUOROSCOPE.

BY JOHN CARBUTT.

1. The cathode rays in an excited Crookes tube viewed through a pale yellow screen, shows increased brightness of the yellow rays.

2. Viewed through a dark violet screen, the cathode rays present a phosphorescent glow, similar to that in a low volt lamp when held in the field of an induction coil.

3. Viewed through a green screen the cathode rays present to the eye a light emerald green.

4. Viewed through a dark red screen, the cathode rays present a pale red, on the carmine tint.

The screens are of thin polished plate glass 1½ m. m. thick, coated with gelatine, colored with aniline dyes, such as I use in making my photochromic screens.

Examination of Röntgen rays through plain glass and the afore-mentioned screens, shows that both cut off or absorb fully 50 per cent. of the Röntgen rays from reaching the screen of the fluoroscope. Screens of the following colors were placed side by side with the clear glass, viz., dark violet, green, light yellow and dark red, and when in juxtaposition, it was impossible to recognize which was clear glass and which was colored, and the eye was unable to detect any color sensation when looking through the fluoroscope with the colored screens in close contact.

These experiments confirm me in the opinion I have held from my first dealing with the Röntgen rays, that they are of the ultra ultra violet, because I find they absorb the entire spectrum, while a deep violet screen absorbs all but the red.

It was early determined by Prof. Röntgen that the X-rays could neither be deflected nor refracted, and I am not aware of any experiments having been made to determine the absorptive powers of the X-rays of the colors of the spectrum.

MR. EDISON'S X-RAYS EXPERIMENTS ON THE BLIND.

A LITTLE over a week ago the "Democrat and Chronicle," noticing that an editorial had appeared in our contemporary, the Rochester "Herald," giving Mr. Edison the credit of discovering that by means of the Röntgen ray some blind persons had been able to discern light, said that "Mr. Edison has laurels enough of his own without having those belonging to others placed upon his brow," and that "we don't think Mr. Edison would claim the credit of a discovery made by another man."

These remarks were based upon the fact that four days previously a dispatch had been received from San Francisco stating that Dr. G. Waverly Clark, a physician of that city, had made the discovery attributed to Mr. Edison. Our judgment was naturally confirmed by another dispatch sent out later to the effect that "Thomas A. Edison has verified the experi-

ments reported to have been made in San Francisco in which by means of a cathode ray a blind boy had been enabled to distinguish light."

It appears, however, from the following note from Mr. Edison that he is the original discoverer and that an article from him was in print before the San Francisco dispatch was published. The following is Mr. Edison's note, which we take pleasure in printing:

"Editor Rochester Democrat and Chronicle:

"Dear Sir: Article announcing discovery that a person blindfolded can see moving objects without the aid of a fluoroscope by the X-ray was sent to The Electrical Engineer, New York, and was in print before the San Francisco article was published there.

"I did not, however, experiment with blind persons. Nothing can be seen by the aid of the fluoroscope when one is blindfolded as stated in the San Francisco article, and there is good reason for the fact, because the X-ray, acting on the fluoroscope, is turned into ordinary light. The ray does not pass through to the eye. Last evening at the laboratory a child totally blind was made to see her hand and other objects by the X-ray, but nothing could be seen through the fluoroscope. It is difficult to imagine that the statement in the California paper is correct. Yours truly, THOMAS A. EDISON."

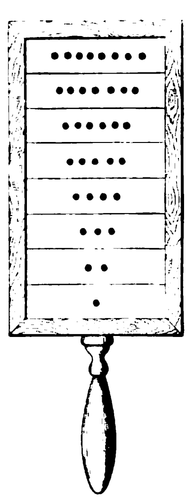
It is obvious from the above that Mr. Edison in this case, as in so many other inventions and discoveries, is the pioneer and entitled to the honors. The statement he makes in the note to this paper is of scientific interest in itself, not only in attesting the genuineness of his discovery, but in explaining the conditions of its successful application up to date.—Rochester (N. Y.) "Democrat and Chronicle."

A NEW X-RAY METER.

BY DR. F. S. KOLLE.

THE accompanying sketch represents a new X-ray meter, devised and used by me since November 12, with excellent results, being both handy, small and reliable.

It consists of a small mahogany frame and handle, grooved to contain eight sections of sheet aluminum, ranging from 1 to 12 mm. The sections have a consecutive number of holes drilled in them, filled with plugs of No. 8 lead wire, in such a way that No. 1 (1 mm.) upon being held in front of the fluoroscope and exposed to the ray emanations, a light area of cer-



KOLLE'S X-RAY METER.

tain dimensions and containing a black spot in its center, would be seen.

As the potential or tube efficiency is increased one section after another would become more or less transparent, all showing the dark spots, in the number corresponding to the plugs. No. 8 is 12 mm. thick and when perfectly transparent corresponds to an X-ray efficiency sufficient to make a radiogram of the adult chest and shoulders in from ten to eleven minutes, using the ordinary 60 sensito-meter dry plate and 10 to 12-inch spark coil.

The instrument can readily be made by any one, and can be adapted to suit its operator and apparatus. The quadrant of sections made by Reynolds and Branson, Leeds, is confusing, whereas in this instrument the operator does not stop to center the dots, as he becomes accustomed to the scale quite readily.

LETTERS TO THE EDITOR.

THERMO-ELECTRICITY HISTORY.

In 1801 it was noted by one Ritter that a current of electricity flowed in a wire when the two ends heated to different temperatures were pressed together. (Wiedemann, Vol. I., p. 627.)

Seebeck noted the same of two metals when one junction was heated. (Pogg. Ann. 1826.)

Magnus, in 1851, made further contributions to knowledge of the single metal current (Pogg. Ann. 1851), followed by Wiedemann, Becquerel, Matteucci and others.

Sir William Thomson in his Thermo-Dynamics gave mathematical and physical theories for the same. (See also Proceedings of R. S.)

Le Roux, in 1867, in a public lecture, showed an experiment with a sheet of copper, and a copper wire brought down to the same. This apparatus gave a current, and the lecturer drew attention to the part taken in the result produced by the oxide of copper at the end of the wire. (Ann. de Chim. et de Phys. 1867.)

In The Electrical Engineer of Aug. 5, 1896, Mr. C. J. Reed announces his new discovery of an electrical current produced by one metal, and so great is the importance of the discovery held to be that he coins a word for the name of the phenomenon, and the editor stands sponsor for the fact of the discovery, and suggests the possibility of utilizing the phenomenon for the purpose of obtaining current direct from coal.

Brooklyn, N. Y. HENRY D. HOOKER.

(The editor did nothing of the kind.—Eds. E. E.)

WANTED—A DEFINITION.

I should like to have a definition of the term thermo-electricity, as used by Mr. C. J. Reed in his article on the Jacques cell in your issue of December 2. My understanding of the term is, electrical energy developed by direct transformation of heat energy. If this is the meaning, then the fact that "the current obtained corresponds exactly to the electro-chemical equivalent of the carbon consumed and the carbonic dioxide produced" is proof positive that the action is not thermo-electric unless the e. m. f. of the cell is away below the theoretical e. m. f., which is not the case.

There is no avoiding the law of thermo-dynamics by transformation of heat into electrical, any more than by its transformation into other forms of energy, and if the energy of the carbon-oxygen separation were first transformed into heat and then from heat into electrical energy, only a small fraction of the total energy could be recovered, the balance going to heat up the cell.

If the electrical energy obtained from the Jacques cell is the equivalent or nearly the equivalent of the energy of the carbon consumed, it is proof that the energy of chemical separation of the carbon and oxygen is directly transformed in the cell into electrical energy.

New York, Dec. 2, 1896. WM. A. ANTHONY.

THE TRUTH ABOUT DR. LARDNER.

I find the following at the end of a paper on "Telephone Repeaters," by Mr. Thomas D. Lockwood, in the "Electrical World:"

"The versatile and brilliant writer and lecturer, Dionysius Lardner, while proving it to be absolutely impossible for any ship to carry coal sufficient in amount to enable it to cross the Atlantic by steam power, was confuted by the news that the feat had just been performed and that a steamer had arrived."

This statement has been disproved so many times, and it has been so long recognized as a baseless slur on the memory of one of the ablest popularizers of science who ever lived, that when Mr. Lockwood repeats it, it can only be inferred that he has found some new evidence to substantiate it; and I venture to express the hope that this will be soon forthcoming.

In the mean time, it may be pointed out that at the Bristol meeting of the British Association for August 25, 1837, at which it was alleged Dr. Lardner formally asserted the Atlantic steam voyage to be impracticable, two opposing projects then before the English public were under discussion; one being for a line of steamers between the west coast of Ireland and Boston, touching at Halifax; the other for a line direct between Bristol and New York. Lardner strongly favored the first and deprecated the second, because he believed that an unbroken voyage in the existing state of knowledge of steam engineering would not be found as profitable as one made in successive stages.

With singular prescience, he had added to the original sug-

gestion of the Boston-Halifax line the idea of a railway from the Irish terminus to Dublin, and steamers from Dublin to Liverpool connecting with the Liverpool, Birmingham and London Railway, so that the whole route, as he said, "would form one great continuous steam highway between the Capitals of the New and Old World." Such a line, he further insisted, would secure the contract for the British mails, the profits from which would counterbalance the losses due to lack of travel during the winter season.

When the discussion came up, Dr. Lardner said (London "Times" Report): "If there was one point in practice of a commercial nature which more than another required to be founded on experience, it was this one of extending steam navigation to voyages of extraordinary length." He was aware that since the question had arisen in that city it had been stated that his own opinion was adverse to it; that impression was wrong; but he did feel as steps have been taken to complete this experiment great care should be used in the adoption of means for carrying it into effect." Then he went on to advise the use of the best coal, to indicate what he thought the best ratio of power to tonnage, to recommend copper boilers, and the placing of coal in tanks, and finally, after more discussion, he reiterated that he "thought the voyage practicable, but he wished to point out that which would remove the possibility of a doubt, because if the first attempt failed, it would cast a damp upon the enterprise and prevent repetition of the attempt."

The charge which Mr. Lockwood repeats against Dr. Lardner had hardly gained publicity before it was immediately refuted, again and again in England, and later, in this country, when Dr. Lardner lectured here.

It was a suggestive example of the fate which is generally in store for the scientific person who dares to say what he believes, even if it be contrary to the interests of the promoters of an opposing scheme. The promoting tribe in 1837 was no different from its descendants of to-day, and it dealt with Dr. Lardner in that same kindly spirit, and with that perfect Christian consideration which has always characterized certain modern monopolies in dealing with those who have ventured to criticise either their alleged rights or wretched service.

New York, Dec. 2. PARK BENJAMIN.

TELEGRAPHIC STAGNATION AND ITS CAUSES.

In your issue of Oct. 21, you print an editorial headed "Telegraphic Stagnation," which shows that telegraphy is at a standstill without having recovered any of the eight million messages lost in 1894. In your issue of Nov. 18 you have an editorial with the caption, "The Decadence of the Manhattan Elevated," showing that this road has experienced a drop in its yearly traffic of 36,000,000 passengers since 1892.

It occurs to me that as both corporations are under the same control, like policies may have produced like results. The telegraph works with hand Morse, and the elevated burns cheap oil as an illuminant. The telegraph is in the semaphore stage, while the elevated is but an omnibus on stilts. To pay dividends by the "conservatism" found in both cases is like supporting one's self by chewing of gum. It would be better to be more radical and do some outside foraging. I am convinced that for progress it is unfortunate that telegraph managers ever knew the difference between a dot and a dash, or that an elevated railroad manager knows anything about steam. The telegraph manager hears his forty-dollar-a-month operator rushing fifteen words a minute over a five-hundred-mile line and knows by experience that this is the ultima Thule of efficiency. The railroad manager reveling in steam, smoke, cinders and grime frowns upon all electrical "experiments." Early training and a closed mind chain both to their idols for life. Li Hung Chang after his trip around the world found it irksome to hammer the ground with his head nine times on again approaching his exalted Emperor and was exiled from court for a year. Beware of innovations. PATRICK B. DELANY.

South Orange, N. J., Nov. 21, 1896.

SPEED INDICATOR FOR SHIPS.

The Electrical Engineer of Nov. 11 contains one of a series of admirable papers on "Electricity in Naval Life," by Lieut. Fiske, U. S. N., which treats of his speed indicator as used in the U. S. Navy. Some three years ago The Electrical Engineer described substantially the same thing as being my invention. In brief, the following language describes either designs; it is all a good electrical draughtsman would require to make working plans of such mechanism: "A direct connected alternate current generator of the inductor type secured to the driven shaft (the speed of which is to be indicated), in electrical connection with a meter whose dial is calibrated to read in distance units, instead of in volts or amperes."

As a matter of scientific interest, I might add I have gone further in the matter and developed recording mechanism which makes a chart of the engineer's speed at every moment of the voyage. JOHN C. HENRY.

Denver, Colo.

SOCIETY AND CLUB NOTES.

THE INSTITUTE TO DISCUSS THE THEORY OF THE ROENTGEN RAYS.

At the 111th meeting of the American Institute of Electrical Engineers, to be held at 12 West Thirty-first street, New York, Wednesday evening, December 16, a topical discussion will be held, devoted to a consideration of the relation of the Röntgen ray to physics. The discussion will be opened by Professor Rowland and Professor Elihu Thomson, Dr. M. I. Pupin, Dr. A. E. Kennelly, Mr. Osterberg and others have signified their intention to participate.

NEW YORK ELECTRICAL SOCIETY.

The 178th meeting of the society will be held at Columbia College, on Thursday, Dec. 10, at 8 p. m. The evening will be devoted to a demonstration of "How to Test the Commercial Efficiency of Dynamos and Motors," an entirely novel form of experimental lecture. A 3 horse-power dynamo and a 3 horse-power motor will be set up and tested in full view of the audience, by a special corps of experts. Professor F. B. Crocker will describe what is being done, and will make the actual tests; ex-President C. O. Mailloux will take the readings, and President C. E. Emery will record them on the blackboard. The audience will be informed of the reasons why each step is taken; will be able to see how the method of testing is conducted from stage to stage; will see the results placed on the diagram as soon as reached; and will thus enjoy a practical lesson in one of the most important branches of electrical engineering.

PERSONAL.

GEORGE W. BRECK.

The Jacob H. Lazarus scholarship, for the study of mural painting, was awarded last week to George W. Breck, president of the Art Students' League, this city. This scholarship entitles the holder to $1,000 a year for three years, and is paid by the treasurer of the Metropolitan Museum of Art. The successful competitor is obliged to spend these three years in study in Europe. Mr. Breck is about 30 years old. His home is in Washington, D. C. He has been a member of the Art Students' League since 1886,, and its president since 1894. The competitive drawings can be seen at No. 215 W. Fifty-seventh street. This success of Mr. Breck will greatly please his numerous electrical friends, to whom in days gone by his beautiful drawings of mechanical and electrical apparatus, many of which have adorned the Engineer, were a constant delight. He is a genuine and broad talented artist.

MR. C. R. FISH, who has for the past three years been general manager of the Suburban Light and Power Company, Boston, has resigned that position and has accepted a position of salesman under Mr. E. I. Garfield, manager of the New England department of the Fort Wayne Electric Corporation. Mr. Fish is well known in the East, and should make a valuable acquisition to Mr. Garfield's staff.

OBITUARY.

F. G. PRATT.

We regret to announce the death of F. G. Pratt, of the General Electric Company, which occurred November 7 last. Mr. Pratt was born at Keene, N. H., and graduating from the grammar and high schools of that town, entered Harvard. After taking his degree with honors with the class of '84, he returned to Keene, and became sub-principal in the High School in which he had received his early education. This post he filled for three years. He then became idenified with the Boston and Albany Railroad in the office of the Electrical

Superintendent, but his health failing he accepted a position with a suburban railroad, for which he did considerable surveying work. His experience in railroad operation opened up for him a position in the Union Switch and Signal Company. While with this company he invented and patented several valuable devices. In 1892 he entered the employ of the General Electric Company, and shortly afterward took entire charge of the catalogue department of that company. His special aptitudes and the breadth of his technical knowledge, extending as it did not only into the purely catalogue work, but also over the patent and engineering branches of the electrical business, adapted him peculiarly to the duties which fell to him.

Any one acquainted with the vast amount and variety of the printed matter and special information which the operation of such a large company necessitates, and the perfect shape in which it issues from the press will realize the responsibility which rested on Mr. Pratt's shoulders. Mr. Pratt was only thirty-six years of age at the time of his death. He was universally esteemed, and his death will be a source of regret to all who knew him.

MR. C. BAYLISS.—A dispatch of Dec. 2, from Mount Clemens, Mich., says: "Charles Bayliss, manager of the Mount Clemens and Lakeside Traction Company, committed suicide by shooting himself through the heart in his room at the Avery House this afternoon. Bayliss was thirty-two years old and came from Pittsburg six months ago. Family troubles and temporary insanity are the causes alleged for the act."

POWER TRANSMISSION.

CARD MOTORS DRIVING MACHINE TOOLS IN THE PATERSON STATION.

WE show in the accompanying illustrations several admirable examples of direct connected motors operating machine tools now running in the splendid station of the Edison Electric Illuminating Company, at Paterson. These consist of a Smith & Mills 20-inch crank shaper, Fig. 1, the motor operating it running at from 100 to 400 revolutions per minute.

In the Prentice drill, shown in Fig. 2, the speed of the motor is constant and the adjustments are obtained by utilizing the cones already provided for the press; the driving-head is at the

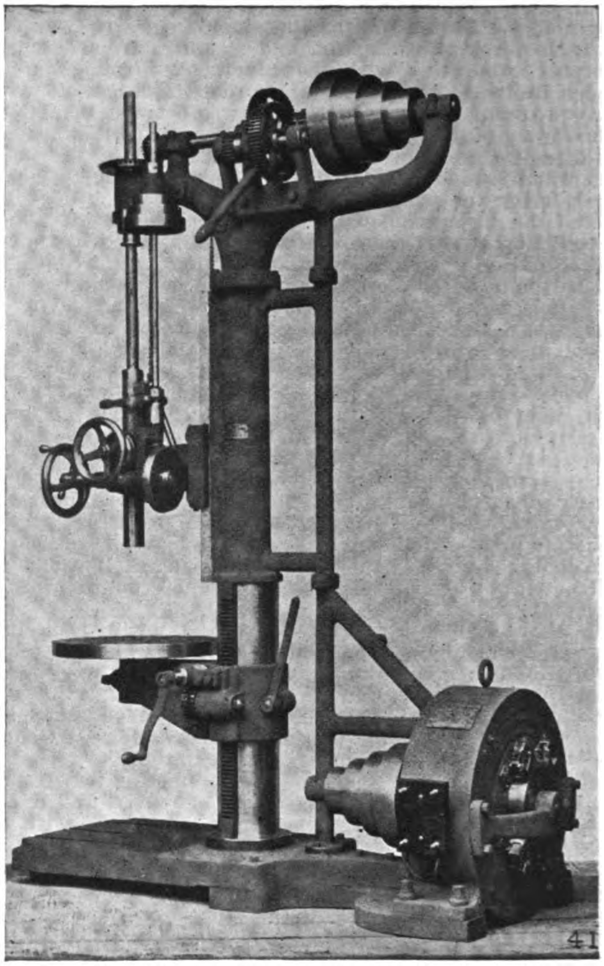


FIG. 2 —DRILL PRESS DIRECT DRIVEN BY CARD MOTOR.

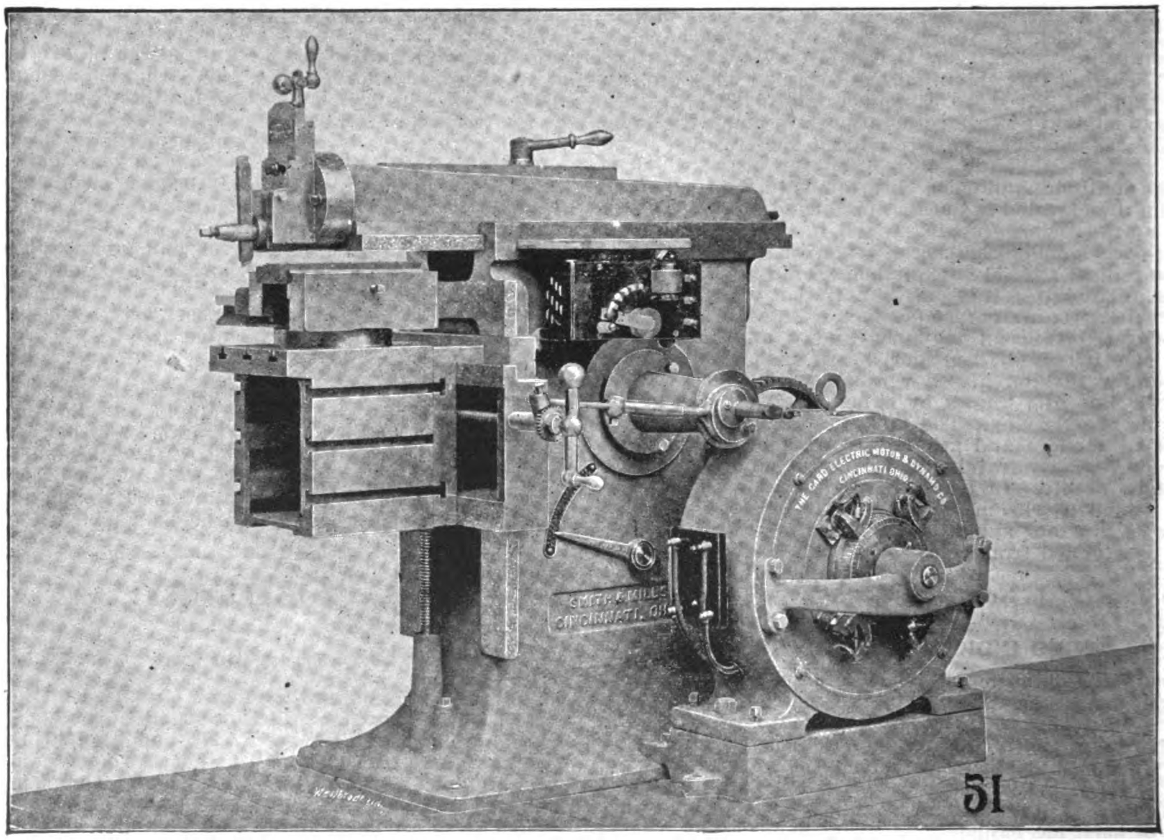


FIG. 1.—SHAPER DIRECT DRIVEN BY CARD MOTOR, PATERSON EDISON STATION.

top of the press; this arrangement proved to be the best balanced one and well suited to the general design of the tool.

In addition to these tools there has been supplied a 24-inch lathe, similar to that shown in our advertising pages, with the motor built in the head stock in place of the usual belted cones, and a 14-inch emery wheel, consisting of a motor carrying the wheels at either end of the shaft extension. These tools are of special interest, because of the fact that the motors are placed direct on their driving shafts.

The Card Electric Motor and Dynamo Company, of Cincinnati, who have supplied all these motors, have in the past two years fully developed the slow speed motor for direct driving, and lay claim to being the pioneers in this field.

MECHANICAL.

COOLING CONDENSING WATER BY AIR VAPOR ABSORPTION.

BY EDWARD F. WHITE, M. E.

WITHIN the past five years marked advance has been made in the method of employing the cooling effects of "air-vapor-absorption," under conditions of induced air circulation over an extensive water surface.

There are at the present time several different designs of apparatus in use, cooling for re-use the heated circulating water from steam engine condensers, the operation of which coolers depends upon the above action.

The accompanying engraving represents one particular form of water cooler, in connection with which an extensive line of experimental tests were lately made at the Stevens Institute of Technology, Hoboken, N. J., to verify the degree of accuracy in the estimated relative proportions, that is, area of

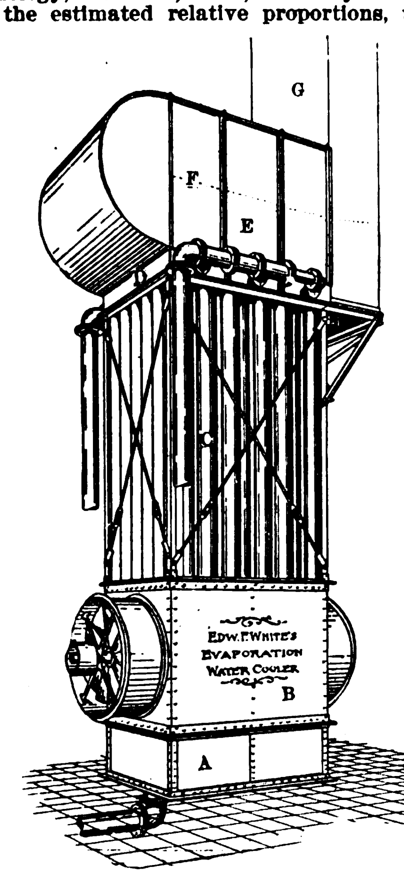


FIG. 1.—WHITE'S EVAPORATION WATER COOLER.

cooling surface, volume of air, weight of evaporation water, degree of cooling action, temperature limits, quantity of water cooled, etc., and to establish a unit line upon which to base capacity estimates for this apparatus.

I believe some of the results obtained will be of interest to the readers of The Electrical Engineer, because little, if any, information based upon actual experiment in this line has been published. In fact, the writer was led somewhat astray by various statements from apparently good authority, made, however, with reference to matters foreign to the subject in hand, which statements I now believe to be incorrect.

For example, it has been stated that "at best, as a carrier of moisture, hot air cannot in practice be charged beyond half its full saturation." This conclusion was arrived at, I believe, by experiments with hot air drying chambers. Another authority records the proposition that "the rapidity of evaporation is the same whatever may be the temperature of the air." That water is evaporated more rapidly when a current of warm air blows over it than when it is traversed by a cold current is a fact that has been noted by engineers operating steam plants condensing by means of evaporation cooling, the record being that "a better vacuum is kept on warm summer days with a fresh breeze blowing than on a cold day with but slight air movements." This is doubtless due, at least in part, to a more rapid removal of vapor by an atmosphere whose capacity for moisture is much increased, due to the higher temperature, and possibly also, in some cases, to the effect of warm air upon the water surface, raising its temperature and thereby diminishing its internal pressure so-called, or its tendency to vaporize on the warm summer day, which is not the case in cold weather.

Before the apparatus was in shape numerous experiments, and notable changes, very considerably modified the ideal condition originally assumed and proportionately the anticipated results.

The four tests recorded in the following table are arranged in the order of increasing temperatures of fan exhaust, and decreasing volumes of circulating water, under which conditions a fairly uniform rate of steam condensation seems to have been maintained of about 173 pounds per hour from temperature corresponding to 4 pounds gauge, to water at 125 degrees F.; while for the high temperatures of fair exhaust (and consequently of circulating water) the vacuum fell proportionately:

Extract of test: White's Combined or Self-Cooling Surface Condenser.

Number of test.	4.	8.	5.	9.	Average.
(1). Square feet evaporating surface per pound of steam condensed per hour, equiv. (4 pound gauge, to 125 degrees F)	.28	.308	.258	.257	0.27
(2). Pounds evaporation per pound steam condensed; equiv. (4 pounds gauge pressure to 125 degrees F.)	1.04	1.07	1.0	.98	1.02
(3). Cubic feet fan exhaust per pound steam condensed (4 pounds gauge p. to 125 degrees F.)..	300	208	204	175	222
(4). Efficiency of cooling action equal to B. T. U. steam condensed, divided by B. T. U., corresponding to vapor absorbed	75%	82%	80%	82%	80%
(5). Final temperature fan exhaust	110°	122°	124°	129°	121°
(6). Pounds circulating water per pound steam condensed (4 pound gauge at 125 degrees F.)	61.7	55.	39.5	39.	49.
(7). Average vacuum—					
Mercury col...........	24.	22.6	20.9	21.	22.
Due to temp. hot well.	24.3	25.8	20.4	20.	22.6

During the entire series of tests the indicated horse-power required to drive the fan was about constant, while the power to drive the pump of course varied in proportion to the quantity of water delivered. This total power, under conditions of maximum duty, was about 6 per cent. of the power represented by the steam condensed, handled, taken at 18 pounds per horse-power per hour.

Both the fan and the pump in this case were at a decided disadvantage, due to necessary local arrangements, and it is fair to say consumed in the amount stated double what would have been required under ordinary good conditions.

It will be noticed that the feature of this apparatus consists of a construction based upon positive unit measurements of the effective cooling or evaporating surface, the accuracy of which unit appears from the uniform results—see (1) in table—obtained in the conditions of a saturated fan exhaust, and, consequently small volume of same per pound of steam condensed—see (3). (Note.—The excessive quantity of evaporation water was not due to entrained moisture lost, but to mechanical losses in the connection, etc., which amounted to about 7 per cent. This however, is included in the weights recorded, and, therefore, affects the results unfavorably to that extent).

By careful hydrometric and temperature tests of the escaping fan atmosphere, it was determined that in a tin pipe ex-

haust leader of the same size as the fan opening, the temperature of escaping vapors fell approximately 1 degree F. for each foot of pipe length. In other words, by carrying the fan exhaust in a vertical thin metal pipe out of doors to a height of about fifty feet, from 60 to 90 per cent. of the absorbed moisture may be recovered as pure water for boiler purposes independent of oily hot well discharge, which latter may be turned into the circulating water tank, where the grease can do no harm; in fact, where the grease will be largely separated by decantation or overflow from the cistern. Finally the air circulation was induced by an exhaust fan instead of blowing, as would be the case in the arrangement shown in the illustration. Theoretically, the decreased resistance in the fan (due to the comparatively low density of the saturated warm vapor) would be offset by the increased volume of discharge over and above that at the initial temperature of the air. But of the fact that the high degree of saturation, as also the ample air circulation obtained, were largely due to this arrangement there is no doubt, thus directly increasing the efficiency of the cooler.

The following is a description of the cooler shown in the engraving. The apparatus tested being an element (single) of this arrangement. The essential parts are the foot tank A, fan-box B, concentric cooling tube systems or element C, and the water disturbing box D, containing the heads, and the hood-stack connection E. The hot water enters through the box D, the several cooling tube systems at the top, and by means of the specially devised distributing heads, is sent down

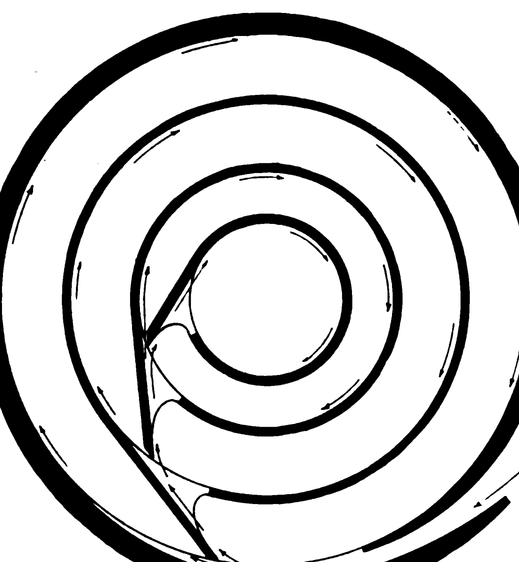


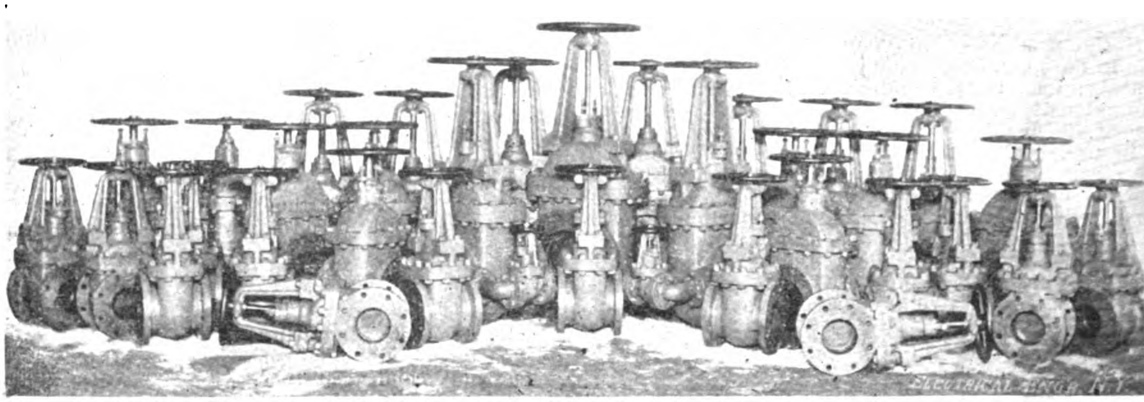
Fig. 2.—White's Evaporation Water Cooler.

spirally along the inside surfaceof the tube, Fig. 2, the volume of which tube forms a straight smooth passageway for the air current. By means of the hood E any entrained water is separated by the baffle plate F, while the water settling from the cooling vapors as they escape through the stack G finds its way back to the cooler and cisterns below, or may be collected at the stack base and used separately as pure water. By placing the fan at the hood and stack junction the headroom of the cooler would be lessened by the height of the fan-box; the space below, in that case, would be done away with.

The construction of this apparatus is almost entirely of riveted leader pipe, galvanized. The tank below shown, of ordinary tank iron, would, if the cooler were located on the ground, naturally be a masonry pit. It need hardly be stated that the exposed position of the cooling tubes adds very largely to the effectiveness of the apparatus.

THE EATON, COLE & BURNHAM CO'S VALVES.

ELSEWHERE in this issue, in an article descriptive of the new station of the Edison Electric Illuminating Company, of Paterson, N. J., mention is made of the valves used in the construction and operation of the plant. More extended notice than could be accorded them in that article seems to be deserved.



Eaton, Cole & Burnham Co.'s Steam Valves Furnished to the Paterson Electric Illuminating Co.

Through the courtesy of the Eaton, Cole & Burnham Company, who are manufacturers of the appliances mentioned, we are enabled to present to our readers an illustration of a portion of the valves which are in use in operating the plant. As will be seen in the accompanying engraving a great variety of sizes and designs enter into the application of these valves to the purposes for which they are used, and to the duty they have to perform.

In constructing valves for the high pressures which are involved in running the engines of electric plants, great care is necessary in selecting the material from which the various parts are to be made. Not only is a great strain upon the material to be provided for, in consequence of the high pressure of steam, often superheated, but expansion and contraction in the lines must be considered; this is true not only of the valves but of the numerous fittings of differing shapes which are required for branching lines, turning corners, etc. In the plant in question each part or piece was designed with reference to the requirement of the place in which it was to be used, and although these fittings are not shown in the cut they were manufactured by the same company.

The high pressures, to which we have alluded, make necessary quite frequent renewal of packings about the various movable parts of the valves, and this must quite generally be performed while the steam is running through the valves. A very efficient device to admit of this repacking under pressure has been placed in these valves and overcomes what otherwise might prove to be a serious inconvenience in the continuous operation of the plant.

As an indication of the mass of material used in the construction of electric plants, it may be mentioned that simply the group of valves illustrated, and which form by no means a large part of the outfit, amounted to a large carload both in volume and weight.

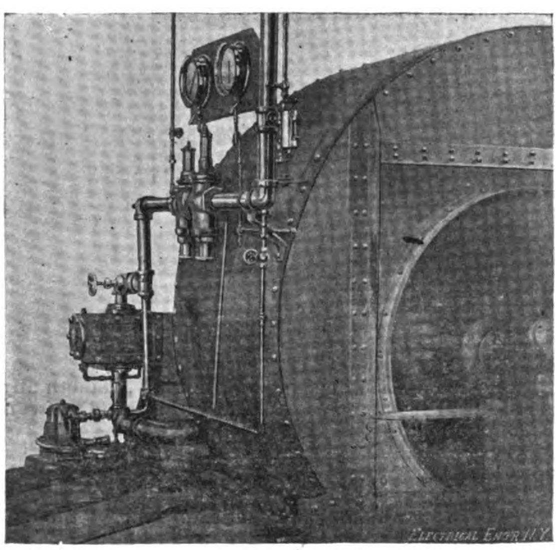
THE BECKMAN SYSTEM OF AUTOMATIC FORCED DRAFT REGULATION.

IT is an acknowledged fact that the more even the pressure on a boiler can be maintained, other things being equal, the greater will be the economy in coal consumption. Indeed, an even pressure card is prima facie evidence of a well-fired boiler. But even with the most experienced and careful firemen considerable variations will occur and hence an apparatus which makes the maintenance of proper pressure inde-

pendent of the fireman is evidently of great value. This was recognized when the new station of the Edison Electric Illuminating Company, of Paterson, which is described elsewhere in this issue, was designed with the result that the Beckman system of undergrate forced draft regulation was installed in connection with fan blowers.

The Beckman system, which is illustrated in the accompanying engraving, consists of a simple arrangement of three moving valves placed as a unit in the steam pipe to the engine driving the fan. These have no more moving parts and are sure to drive the fan at the highest speed to produce the necessary quantity and pressure of air for burning the fuel at its maximum efficiency and producing the greatest heat under the boiler that the water is capable of absorbing. The stack damper is set to hold back this heat so that the escaping gases do not leave the uptake at a temperature much above the temair to keep the grates cool and the fires bright. When the steam pressure in the boiler has reached the desired point, the regulating valve cuts off the direct supply of steam to the fan engine, and would stop the fan, but for the introduction of a by-pass having a reducing valve introduced in its line which furnishes just sufficient steam at a very low pressure, from 5 to 8 lbs. This keeps the fan revolving, supplying enough air to keep the grates col and the fires bright. When the steam pressure falls two or three pounds, the regulating valve opens and steam is admitted to the fan engine, which immediately furnishes air to burn the coal fast enough to restore the desired pressure.

The fireman does not have to watch or adjust any valves or dampers, but can give his undivided attention to keeping a sufficient amount of coal on the grates, either by hand firing or



THE BECKMAN SYSTEM OF FORCED DRAFT REGULATION.

mechanical appliances. Fine coal and even coal dust, can be burned economically by this system. There are as many British thermal units in a pound of coal dust as in an equal weight of lump coal; the difficulty has been to get air through a mixture of this kind, fast enough to make steam, the tendency being for it to lie on the grate bars baking and distilling Having a fan automatically controlled to furnish the proper amount of air at the proper time and pressure, this cheaper fuel can be burned fast enough to produce steam at a very marked difference in cost. This saving in cost has been in one case, 50 per cent., owing largely to the inefficiency of natural draft to furnish sufficient air to burn even a high grade of coal.

The system illustrated was installed in the Paterson Edison station by the Kensington Engine Works, of Philadelphia, and has already been applied in a number of other central stations and large power plants.

MR. KNUTE O. HAGEN writes us from Iowa: "I have now been taking your paper nearly a year and I am glad to say that I am very much pleased with it. I have some other papers, too, on the same subject, but I consider yours the best of them all."

MR. H. C. TOWNSEND, the well known patent attorney, is the subject of an illustrated biographical sketch in the "Banking and Law Journal" for October.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

AFTER THE BERLINER DECISION, WHAT?

"The Electrical World" contained an article from the pen of Mr. E. L. Frost, with reference to the Berliner case at Washington, and its conclusions are apt to lead the public into a fear that the Berliner patent is to be sustained sufficiently to prevent the use of telephone instruments of the Microphone type.

The writer has followed the Government cases carefully, from the beginning, and listened attentively to the arguments before the Supreme Court. The labored and flowered ordeals of the Bell counsel might indicate, to an ordinary listener, abundance of advantage. The records and briefs, however, appeal to the writer as having sufficient meat to make a much stronger case for the Government than appears from the oral arguments. The Supreme Court is more apt to be guided by the printed briefs and records than by the flowery or labored speeches of either side.

However, the thing which most struck the writer was the interest shown, at times, by the Supreme Court Justices sitting in the case. Justice White, interrupting the Bell counsel, asked: "Do we understand that the Berliner patent en suite covers the Blake transmitter?" Mr. Fish replied: "Yes, sir, it covers all forms of microphones." Then Justice White asked: "Do I understand also that the Blake transmitter has been in use by the Bell Company for over eighteen years?" Mr. Fish flushed and stammeringly replied affirmatively, while the entire courtroom, including the Justices on the Bench, seemed to feel the significance of the questions and answers, as Justice White leaned back and said, "Very well, very well," and Justice Harlan plainly acknowledged acquiescence. This, together with several questions asked by the Justices, were leading to the impression that the Supreme Court was getting into the case deeper than the oral arguments.

The writer's opinion is that the Supreme Court will be divided; that not less than four Judges a majority of those sitting, will be of opinion that the Berliner patent should not be sustained sufficiently to be dangerous; that others may be affected by legal technicalities, which did not strike Judge Carpenter as sufficient.

However, the public need not conclude that the action of the Supreme Court in this Government case is so far-reaching that microphone transmitters may be monopolized by the American Bell Telephone Company. There are a great many defenses to the Berliner patent not raised in the Government case. In fact, evidence is at hand which will absolutely show the patent to be worthless, and it may be added that no intimation of this evidence appears yet to have discovered itself outside of the channels controlled by the Western Telephone Construction Company. Perhaps the writer is mistaken, and that "history will repeat itself." It is possible that the Bell Company also knows of this evidence, and are attempting to quietly "work the courts," through the Berliner patent in some such manner as they attempted to "work the courts" upon the Watson patent, until we suddenly terminated it.

The writer desires to assure the public that in case of suit upon the Berliner patent against the Western Telephone Construction Company, or its patrons, the Berliner patent will be defeated without question, and in much simpler and shorter order than Mr. Frost's article would seem to indicate.

J. E. KEELYN,
President Western Telephone Construction Company.

THE BRYANT ELECTRIC CO. BRANCHING OUT.

The Western supply trade will note with interest the establishment of a branch factory at East Liverpool, Ohio, by the Bryant Electric Company, manufacturers of the well known "Bryant specialties." The Bryant Company state that it is not their intention to manufacture their complete line of supplies at East Liverpool, but for the present will confine their work at that point to Sawyer-Man cut-outs, 500-volt railway blocks, and the well-known K. W. ceiling rosettes, and that the manufacture of other specialties will be added as necessity demands.

The largely increasing Western trade of this company has made necessary the move outlined and the advantages resulting to the supply trade in the way of early deliveries and reduced freight rates are very apparent. The Bryant Company

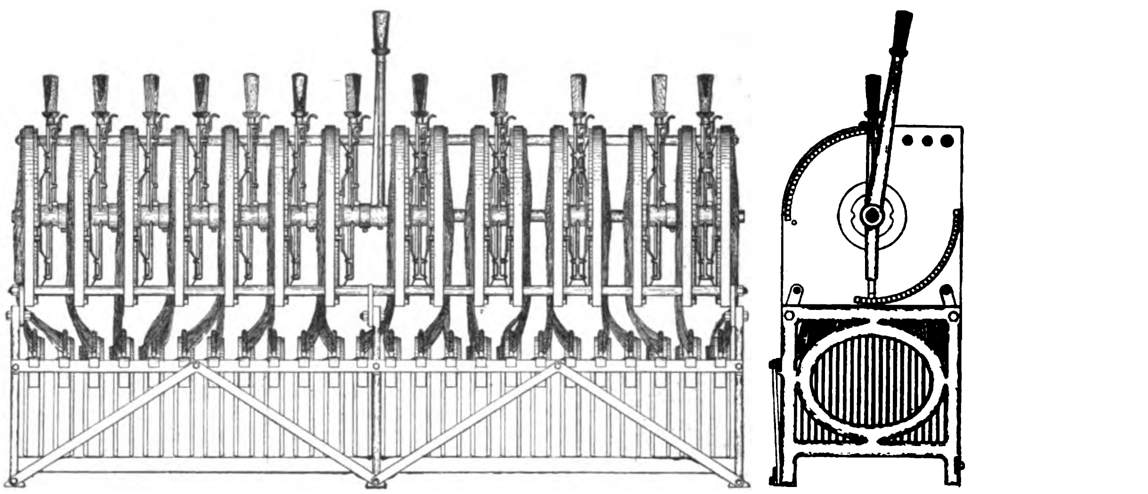
will establish no business office at East Liverpool, and all correspondence should be addressed as formerly, either to their Western office at Chicago, or the main office at Bridgeport, Conn.

IRON CLAD THEATRE DIMMERS.

THE progress of theatre lighting and the control of electric light for scenic effects is of interest alike to the theatrical profession and to the constructors of theatre lighting plants.

The Iron Clad Rheostat Company of Westfield, N. J., are leaders in improvements in theatre dimmers, and among the recent improvements made by them is an interlocking switch system. Where several dimmers are used, a system of interlocking the switch handles, so that any or all of the dimmers can be operated by one central master bar, is indispensable. The long experience of the Iron Clad Rheostat Company in the manufacture of theatre dimmers, and the success they have met in all classes of this work assures intending purchasers of desirable results. Where particularly fine effects are desired this style of theatre dimmer meets all the requirements.

The bank of theatre dimmers illustrated herewith was built for one of the largest theatres in the country. It is composed of four 3-wire dimmers and eight 2-wire dimmers, ranging in capacity from 40 lights to 200 lights each, a total of 1,150 lights; dimensions 78x37x20 inches exclusive of handles. The completed instrument is very neat, compact and substantial, and fulfills the specifications of fire departments and insurance underwriters.



Iron Clad Rheostat Co.'s New Theatre Dimmer.

In addition to the above described large bank of dimmers, this company recently filled an order for a bank of 24 dimmers complete with interlocking switches. This bank has a capacity of 1,480 lights; dimensions, 120x37x20 inches exclusive of handles. The maximum height to the top of the master bar is 48½ inches.

The several styles of iron clad dimmers cover all possible applications. Dimmers of any capacity from one light to 10,000 lights, in any of a dozen different styles, can be furnished by this company promptly.

THE KENT LUBRICATING COMPOUND.

It is a great comfort to operators of machinery plants to know that the apparatus is well constructed and reliable; but not less ease-giving is the assurance that such apparatus is properly handled and maintained in condition such that its life shall be prolonged and the cost of its operation reduced to a minimum. The cost of work lost in friction and repairs due to the heat generated thereby in machinery is being more and more appreciated by intelligent power users, with the result that the matter of lubrication is receiving its due share of attention, for upon it the life and the economy of machinery largely depend.

In the magnificent station of the Paterson Edison station, illustrated elsewhere in this issue, particular attention has been paid to this point, and as in all the other parts of the equipment and operating accessories, only the very best is employed. To meet the high ideals of the company, the Kent lubricating compound is regularly employed. This compound is largely composed of light mineral oil, chemically united with tallow, giving it the requisite viscosity and softness, and yet requiring a temperature of 350 degrees Fahrenheit to melt it. The result is that the compound does not melt, but stays where it is needed—at the wearing surface. This also means that it is a much cleaner lubricant than the usual oils, the drip from which soon gives most engine rooms an unsavory appearance.

The N. Y. and N. J. Lubricant Company, 30 Cortlandt street, manufacturers of the Kent lubricating compound, issue a neat little pamphlet, showing the best methods of applying the Kent lubricant to bearing surfaces of various kinds. The pamphlet also contains a large number of the most appreciative testimonials from some of the largest power users in the country, as to the value of the compound, and if only half of what is said of it is true, it ought to find a place in every engine and dynamo room.

A NEAT AND USEFUL SOUVENIR.

One of the neatest and most useful little souvenirs that we have yet seen given out by electrical supply houses, has just been perfected by Mr. Hugo Reisinger, of New York City, who, as every one knows, imports the "Electra" carbons. The souvenir is a caliper measure for accurately ascertaining the diameter of carbons, the graduations being marked in inches and millimeters. The measure is made of fine wavy cameo, direct from Paris, and reflects great credit in Mr. Reisinger's judgment and taste. They are at present being presented to Mr. Reisinger's customers, but as they are of considerable value will not be distributed indiscriminately, though any user of carbons desiring a measure of accurate quality would do well to communicate with Mr. Reisinger.

A LIGHTING PARADOX.—OPEN vs. ENCLOSED ARC.

WHENEVER an attempt is made to express the value of the illuminating power of a source of light by designating its candle-power, the result is never a true value of the power of the light. This is because the measurement of candle-power may be the same for lights of widely different qualities. The eye is a much better instrument than the photometer for arriving at an approximate value of the true illumination, because the eye takes quality of light into account as well as mere candle-power. But even the eye is sometimes deceived. As an instance of such deception the following test is interesting.

An inclosed arc lamp and an open lamp were placed side by side for comparative test in a large commission house in New York. The test was made in the afternoon, before the sun had gotten well on the horizon; a number of the members of the concern acted as judges of the lights, and decided almost unanimously in favor of the open arc. When darkness set in another test was made, and the same judges, without exception, unhesitatingly gave the preference to the inclosed arc. Whereas, in the daytime the inclosed arc appeared dimmer than the open arc, after dark the reverse was the case.

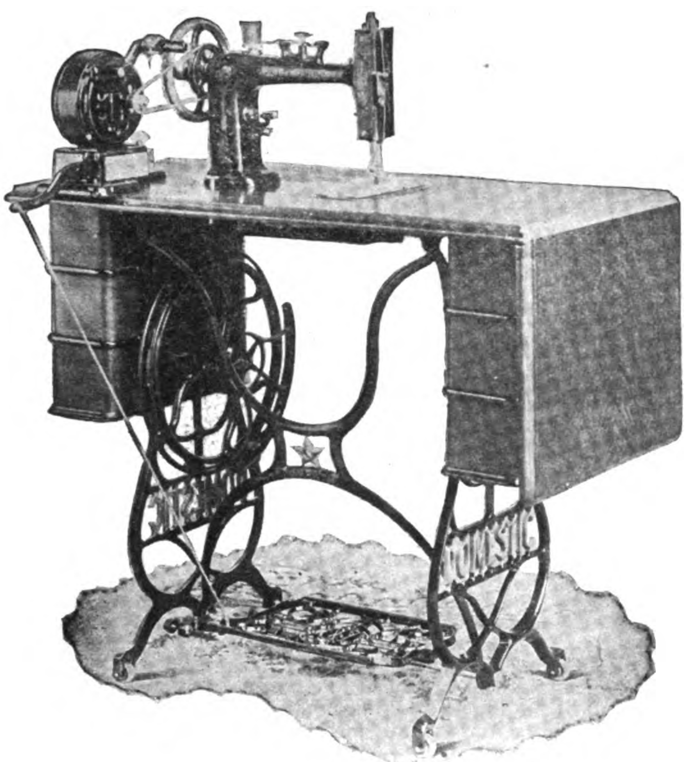
At first sight this seems paradoxical, but the explanation is quite simple. The quality of light rays emanating from the "Pioneer" lamp, which is the inclosed arc above referred to, approaches so closely that of daylight that during the daytime the light of this lamp appears dim compared with the light of an open lamp, whose quality is radically different than that of the sunlight; and, by virtually taking the place of daylight the inclosed arc is actually much brighter than the other lamp, and appears so to the eye. Compared with the "Pioneer" inclosed arc under these conditions the open lamp looks yellow and dim.

The only time to get a practical measure of the value of the light is when darkness sets in. That is when the light is used, and that is when it should be measured. The second test alluded to above was naturally the one to which most importance was attached, and resulted in a signal victory for the "Pioneer" inclosed arc. It is safe to say that in the majority of cases, especially where proper quality of light is necessary, this lamp affords an almost perfect substitute for daylight.

THE KENT ALTERNATING SEWING MACHINE MOTOR.

The extended use of the alternating system of electric lighting has created a large demand for small power specialties for such circuits. The Kent Electric Manufacturing Company, of Worcester, Mass., have lately been bending their energies in this direction, and one of their results is a sewing machine motor illustrated in the accompanying engraving.

The great difficulties encountered in this work are the small starting torque, and the non-variable speed of these motors. Both of these obstacles are overcome in the device shown. The motor, which is of the induction type, is mounted on a base, to move with a lever, connected to the treadle of the machine, and the speed regulation is obtained by tightening and slackening the belt. By this method, any desired speed may



The Kent Alternating Sewing Machine Motor.

be maintained. In this way even more perfect regulation can be obtained than by direct current, as the speed can be changed in an instant, and the brake which touches on the circumference of the balance wheel stops the machine instantly.

A switch located on the base is turned on when the operator sits down to the machine. The motor is thus started without a load, and is running constantly while the machine is in use. It is compact, and neat in appearance.

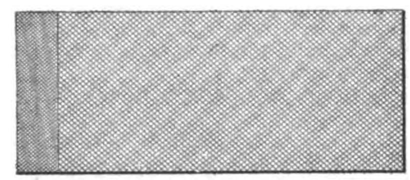
The company also manufacture a variety of other apparatus such as battery fan outfits, alternating current fans, and small machines which can be run either as a dynamo or a motor, capable of lighting from one to four 8 candle-power lamps, or of running a 6-inch fan. The voltage varies with the speed from 1 to 18 volts.

LARGE ADDITION TO THE ANSONIA ELECTRICAL CO'S FACTORY.

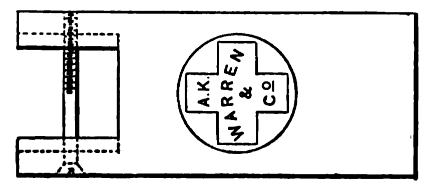
Mr. Thomas Wallace, Jr., vice-president and manager of the Ansonia Electrical Company, of Ansonia, Conn., writes us that they have placed the contract for a three-story addition to their factory. It will be 40 feet by 90, and is already in course of construction. They expect to have it ready for occupancy by January 1, 1897. It will be used to take care of the increased demand for the company's well-known lines of goods, as they do not contemplate at present going into any new branch.

THE WARREN BRUSH EXTENSION.

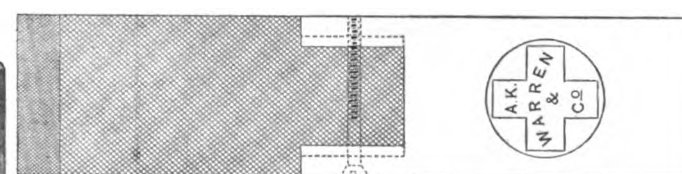
A not inconsiderable expense attached to the operation of dynamos is the cost of brushes, especially where gauze brushes are employed. With the usual form of brush holder the stump remaining is rarely less than two inches in length which means a waste of anywhere from 25 to 50 per cent. of the original cost. An ingenious device for reducing this waste almost entirely is the brush extension manufactured by A. K.



ORDINARY WASTE.



EXTENSION.



COMBINATION.

Figs. 1, 2 and 3.—The Warren Commutator Brush Extension.

Warren & Co., of 451 and 453 Greenwich street, New York. The accompanying engravings showing the device are almost self-explanatory. The brush, as will be seen, has an offset a little over one-half inch in length, which is slipped into an extension socket and secured by a screw passing through both. The whole costs no more than the usual brush, and the device can be used on all kinds of brushes. Old brushes can also be made to fit the extension.

ERICSSON TELEPHONES IN NEW YORK.

Among the recent contracts secured by the Wilson-Bates Electric Company, 136 Liberty street, New York, are two of the largest ever awarded for the equipment of interior telephones. One of these is for the telephonic equipment of the St. Paul building at the corner of Broadway and Ann street, New York, with 359 telephones and the other the Bowling Green Building with 300 instruments. Both these installations will be provided with a telephone in each office connected with a switchboard at the elevator landing on the ground floor. The tenants in each of these buildings will therefore be able to communicate with one another and communication can be had with each office from the switchboard on the ground floor. The instruments will be of the well-known Ericsson Swedish type recently described in The Electrical Engineer.

Among the other buildings recently equipped by the Wilson-Bates Electric Company are the Roosevelt Hospital and the Bloomingdale Insane Asylum.

INTERIOR CONDUIT IN THE WEST.

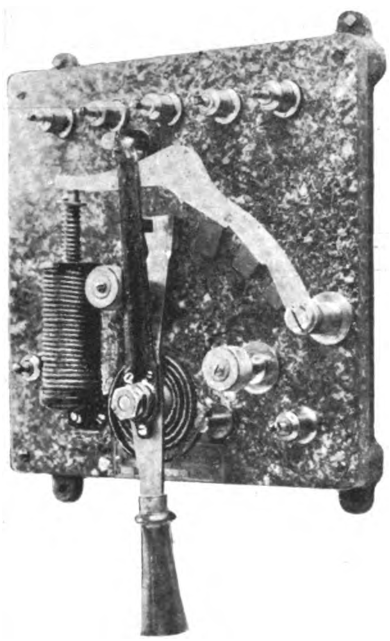
A great deal of interest has been felt in regard to interior conduit in the West, and we are now able to report that the Central Electric Company, so long identified with this popular auxiliary of the wiring business will continue to handle it in the territory where they have sold it so long. At the same time, as noted by us recently, an agency has also been granted to the Western office of the Western Electric Company, for business in that section of the country. The demand for interior conduit appears to be nothing short of illimitable, and the Interior Conduit and Insulation Company have lately been largely increasing their facilities for its production. Through factory changes incident to the introduction of new machinery for this branch of manufacture, the company have moved their

offices to the second floor, leaving the first floor entirely for brass armored conduit alone.

THE STRANGLAND SWITCH.

WHILE the convenience of rheostats is undisputed, their use almost invariably entails a loss of current which is wasted in heating them. To avoid this waste in cases where direct connected series wound motors are used, as with ventilating wheels or fan motors, and generally for work where variations of speed are required, the C. & C. Electric Company, of New York, build the Strangland switch, illustrated in the accompanying engraving.

This switch controls the motor without the use of resistances, its function being to effect the commutation of the field coils. The switch is also designed to automatically cut out the motor for current interruption at any speed.



THE STRANGLAND MOTOR SWITCH FOR SERIES MOTORS.

HUGO REISINGER'S "ELECTRA" CARBONS.

Hugo Reisinger, of 58 Beaver street, New York, reports of an extraordinary increase in the business for the "Electra" high-grade Nuernberg carbons. He recently received the following letter from a leading electric lighting station: "Please enter the enclosed order for carbons, to be of the celebrated "Electra" brand. The shipment furnished us was so far superior to anything heretofore used by us, that we have concluded to adopt the "Electra" carbons exclusively for our arc lighting in the future." The above letter is one of the many testimonials which Mr. Reisinger has received, and certainly speaks very highly for the merits of the "Electra" carbons with which he supplies the trade.

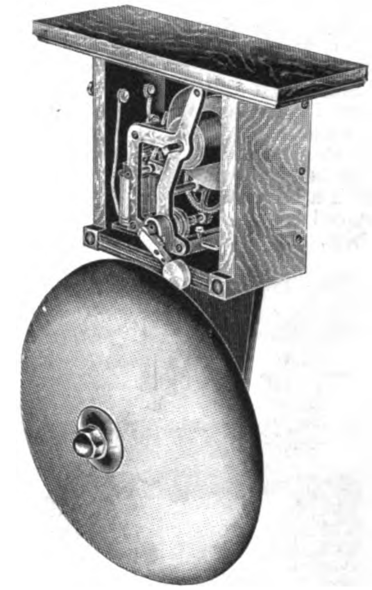
WARREN ELECTRIC CO.

The Warren Electric Co., of Chicago, have consummated quite an important electrical deal in Ohio. They have organized a corporation entitled the Warren Electric Manufacturing Company with principal offices at Sandusky, O. The Warren Electric Manufacturing Company has purchased the large manufacturing plant known as the Barney and Kilhey works, which are complete in every respect, and have a fine equipment of machinery and tools. The buildings which are large and substantial, are built of stone, are most centrally located in the city of Sandusky. The capital of the new concern is $200,000, fully paid up, and the business of the company will be managed by the president, Mr. C. C. Warren, who will make Sandusky his home.

HENRY R. WORTHINGTON COMPANY, manufacturer of pumping machinery, has just received word through its London office that the exhibit of Worthington pumps at the Hungarian National Exhibition at Budapest has been awarded a grand millennium medal. This medal is the only award made for pumping machinery at the exhibition.

EDWARDS & CO'S. NEW ELECTRO-MECHANICAL GONG.

THE new electro mechanical gong manufactured by Edwards & Co., 144th street and Fourth avenue, New York City, is a decided departure from those types now on the market. As will be seen in the accompanying engraving, the hammer is pivoted at the post. When released it makes a full revolution, passing under the gong, and is raised by an inclined plane, strikes the gong a powerful, clear blow and drops to its normal position under the gong. After the first blow the armature remains close to the magnets, so that very little power is required to operate it and very rapid blows may be struck.



THE EDWARDS ELECTRO-MECHANICAL GONG.

The smaller sizes, 4 inches to 8 inches, are encased in a polished wood box with a nickel-plated front, to which is attached the entire mechanism of the bell. By unscrewing this front the whole bell may be removed from the case and the inner parts exposed. Lantern pinions and a very strong spring encased in "main spring box" are used.

The larger sizes, 10 inches to 30 inches, are mounted on a cast frame and entirely encased in a polished wooden box, the front of which can be removed, as shown. The wheels are cast bronze and the pinions of solid steel. This style is made to operate by either a spring or weight, and will strike about 500 blows to each winding.

These bells can be arranged to continue striking single rapid blows until the circuit is broken. Being dust and damp proof they may be used in exposed places.

GORDON-BURNHAM PRIMARY BATTERIES IN FIRE AND POLICE TELEGRAPH WORK.

The Gordon cells which were installed in the Brooklyn Fire Department on March 19, 1896, are still operating successfully. There were thirty cells of the No. 1 type which replaced 40 gravity cells on circuit No. 3. The current discharge at the day of installation was 85-1000 ampere normally at an e. m. f. of 20 volts. At the present time, after being on closed circuit for over eight months, they are showing a current output of 75-1000 ampere, at an e. m. f. of 19 volts. These measurements were taken on Weston instruments by Mr. W. C. Banks, electrician of the Gordon-Burnham Battery Company. This company guarantee their cells on closed circuit work at a current output of 8-100 of an ampere, as required for fire alarm work for six months. This ought to demonstrate to the users of primary battery current of what stuff the Gordon cells are made. They have also been in the Police Department of Brooklyn city; there were installed on Jan. 22, 1896, two circuits with Gordon cells for police telegraph service, which are still going. The maximum current discharge on this work is 25-1000 of an ampere, at an e. m. f. of 11 volts. Mr. Mason, superintendent of the Police Telegraph, and Mr. Walter, Acting Superintendent of the fire alarm telegraph system of the city of Brooklyn, are highly pleased with the successful working of the cells on their circuits.

STAMFORD, CONN.—Among the numerous contracts which the Berlin Iron Bridge Company have secured of late for steel

roofs covered with corrugated iron lined with their patent anti-condensation roof lining, is the roof for the new power station for the Stamford (Conn.) Gas and Electric Company. The layout of this station is very convenient, and the construction is to be the very best. The engine and dynamo room is 60 feet wide and 100 feet long, and the boiler room adjoining is 40 feet wide and 75 feet long. The walls are of brick, and the framework of the roof as well as the supports for the traveling crane in the engine and dynamo room are of steel. The Berlin Company have the contract for furnishing and erecting all of the structural steel work.

ADVERTISERS' HINTS.

CENTRAL ELECTRIC COMPANY carry in stock a variety of special wires for office, switchboard and metallic circuit service for telephone exchanges. Okonite insulation is always used and the wires will be found equal to the severest requirements of the most advanced telephone practice.

THE ALBANY STEAM TRAP COMPANY furnished the steam traps for the Paterson Edison Company's station.

THE C. & C. ELECTRIC COMPANY advertise motors for direct connection to ventilating fans and for direct coupling to blowers, blasts, etc. They also mention their type 4 P. motor for power work.

MITCHELL TEMPERED COPPER COMPANY, Corry, Pa., are supplying copper for all purposes where the tempered metal may be used. Commutator segments and bevel bars are their specialty and customers may be sure of high-grade quality in goods sold under their trade mark "M."

THE GENERAL ELECTRIC COMPANY point out some of the advantages in central station equipment comprising direct current apparatus for distribution over net work of mains, and multiphase apparatus for transmission feeders and tie lines, by transformers and rotary converters.

HASCALL STEAM GENERATOR COMPANY have something to say regarding their system which they install under the condition of forfeiting payment in the event of its not fulfilling their claims for it.

THE McCLELLAND OIL PURIFIER CO., 66 Broadway, New York, have a method of cleaning oil which employs water and heat. Their purifier combines an ornamental storage reservoir as well.

THE NEW YORK AND NEW JERSEY LUBRICANT CO., 30 Cortlandt street, New York, advertise Kent's lubricating compound requiring 350 deg. of heat to melt it. They refer to several large plants where it is in use, among them being the Edison Electric Illuminating Company, of Paterson, N. J.

THE KENSINGTON ENGINE WORKS, Ltd., Philadelphia, advocate the Beckman system of forced draft as a money-saver both in repairs and in the cheaper grade of fuel which may be utilized.

GOLDMARK & WALLACE, 29 Chambers street, New York, are the United States agents for the Koch woven wire dynamo brush. These brushes have met with universal favor in Germany and bid fair to in this country, as well, owing to the many points of excellence which they embody.

E. H. KELLOGG & CO., New York, have dealt largely in lubricating oils since 1858 and their long experience enables them to suit all their customers in supplying the best grades for dynamos, engines, railways, ice machines, steamships, etc.

MR. E. YEOMANS, 60 Canal street, Chicago, is the Western agent for Zimdars & Hunt and is well prepared to fill orders from Chicago stock for automatic switches for electric motors or any of the other specialties carried by this well-known house.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., illustrate in their "ad." this issue, an iron truss roof with a traveling crane both of which were designed and built by them for the Narragansett Electric Lighting Company, of Providence, R. I. The side walls are of brick, making a fireproof structure which should commend itself for central stations or other uses where the fire risk is ordinarily great.

THE EVANS MARBLE COMPANY, of Baltimore, devote special care to the supply of marble for switchboard slots and interior work. One of their recent shipments was for the switchboards in the station of the Edison Company, of Paterson, N. J. The marble was quarried to bring out the veins and the boards present a very handsome appearance.

THE KEUFFEL & ESSER COMPANY, 127 Fulton street, New York, say they have the largest and best stock of drawing materials and surveying instruments in America. Engineers and those interested will do well to drop them a card and receive their catalogue.

THE ELWELL-PARKER ELECTRIC COMPANY, of America, build a complete line of modern direct connected slow-speed and belt-driven moderate speed dynamos for power, lighting and electro deposition work. They also make standard motors for driving shop power tools, pumps, hoists, cranes, etc. Their catalogue is ready for distribution.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., advertise generators and motors of superior design and liberal proportions, low temperature and high efficiency.

THE KENT ELECTRIC MANUFACTURING COMPANY, 47 Hermon street, Worcester, Mass., are placing on the market sewing machine motors for which they claim absolutely perfect speed regulation. They are made for family and factory use.

THE GILMORE ELECTRICAL AND MANUFACTURING COMPANY, North Easton, Mass., give five reasons why the "96" cut-out is the best. They claim special advantages for their fuse blocks, of which they carry a complete line, and on which they will be glad to quote prices.

THE ELECTRIC STORAGE BATTERY COMPANY point out the advantages of a battery of chloride accumulators in an office building. It acts as a regulator of potential permitting the lamp and elevator services to be taken from one generator, which is run at normal steady load and it furnishes the night service at a minimum cost.

THE BALL & WOOD COMPANY, 15 Cortlandt street, New York, have installed for the Edison Electric Illuminating Company, of Paterson, N. J., six 600 horse-power and one 450 horse-power engines of the fine type shown in their "ad." They are now building for the same company two 750 horse-power vertical engines of the same general type but designed for rope transmission.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, publish a partial list of exchanges using their apparatus, representing over 22,000 instruments.

McLEOD, WARD & CO., 27 Thames street, New York, direct attention to the Kinsman desk lamp which has proved itself of great value in offices where the light is poor.

THE GENERAL INCANDESCENT ARC LIGHT CO., New York, illustrate the special quick break switches designed for the Edison Company, of Paterson, N. J., and also the new Bergmann enclosed arc lamp which they claim to be the best and cheapest 150-hour arc lamp on the market.

THE IDEAL ELECTRIC CORPORATION, New York City, are well prepared to furnish switches and switchboards of any size and for every class of work.

ROSSITER, MACGOVERN & CO., New York, present a very excellent list of bargains in dynamos and transformers.

M. E. SANGER & CO., 36 Cortlandt street, New York, remind their friends that they are thoroughly equipped for the manufacture of intricate and special devices. The feeder indicators in the Paterson Edison Company's station were constructed by this firm.

JOHN W. FERGUSON, 253 Broadway, New York, was the contractor for the station of the Edison Electric Illuminating Company, of Paterson, N. J.

WM. TAYLOR, 203 Broadway, New York, draws notice to his enclosed 150-hour arc lamp which he will send on trial to possible purchasers. "Take him up."

THE IRON CLAD RHEOSTAT COMPANY, Westfield, N. J., have a large variety of rheostats for all general uses and make a specialty of theatre work.

THE BRODIE ELECTRIC COMPANY, Manchester, N. H., recommend the "Brodie" single-pole combined switch and fuse box for high tension currents. It is intended as a primary cut-out for use with transformers and in general outside construction work.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., present a cut of an American-Ball engine which has received the best work of Mr. F. H. Ball, whose efforts in engine building have always been crowned with success. Some of the new features are larger crank shafts, automatic circulation of oil and a governor which embodies fine regulation.

HERRICK & BURKE, 150 Nassau street, New York, were the engineers who planned the station of the Edison Electric Illuminating Company, of Paterson, N. J., described in this issue.

THE EATON, COLE & BURNHAM COMPANY, New York, are the manufacturers of the "Eaton" iron body, bronze mounted, gate valves for high pressures.. These valves are fitted with double, parallel faces and are adapted for electrical and other steam plants where high pressures are used. They also furnish fittings of all sizes and steam metal valves, and cocks for ordinary and heavy pressures.

CUTLER-HAMMER ELECTRICAL GOODS.—In calling attention to the special announcement of the Cutler-Hammer Manufacturing Company, of Chicago, in this issue, it may be noted that the company have been enjoying a fine rush of business since the election and have booked orders during the month of November that amount to more than double that in any previous month. Mr. E. W. Hammer informs us that they find the demand for their starting rheostats specially ac-

tive, due in part to the very low prices they have made on their smaller sizes. They have been compelled to increase their force largely and are now working overtime to keep up with orders. The company invite correspondence as to any of their specialties.

K. McLENNAN & CO., of 206 Dearborn street, Chicago, sole manufactures of the celebrated Gale's Commutator Compound, stated to a representative of The Electrical Engineer, that they would keep open their invitation, extended through the columns of this paper, to all users of generators and motors, who are troubled with sparking and cutting of commutators, to send to them a free sample stick, for some time to come. Through the columns of this paper, they will report the results of trials, and all who have not tried this compound should write to them for a sample and convince themselves of its merits.

THE C. W. HUNT COMPANY, New York, are glad to answer any inquiries concerning coal handling problems and will send their catalogue, "Coal Handling for Steam Generators," to any one interested in these matters.

HENRY W. BULKLEY, 39 Park Row, New York, advertises the Bulkley "Injector" condenser and points out several of its commendable features.

MINER & CO., 1366 Broadway, New York, make a specialty of electric signs for the trade, keeping in stock 18-inch, 24-inch and 36-inch block letters. They also make to order script and other unique designs.

HINE & ROBERTSON, present a very "pat" cut, "Help the Blind," in their advertisement, and suggest how many electric light and power plants are simply guessing that their engines are doing well, whereas if they owned an indicator, cards could be taken every day giving to the engineer very valuable knowledge and to the manufacturers of the plant an absolute knownedge that full power is being developed for the amount of coal consumed. The cost of an indicator is now within the reach of every one, and the day not far distant when every power owner will have one.

THE STIRLING COMPANY, Chicago, state that they have installed over 350,000 horse-power of their water tube boiler, claiming it to be the ideal boiler for central stations and street railway work.

THE WHEELER CONDENSER AND ENGINEERING CO., New York, call attention to the Barnard water cooling tower designed for steam plants where a natural supply of water for condensing purposes is not obtainable. They guarantee its efficiency and durability, while the cost of operation is small. They have removed to the Beard Bldg., 120-122 Liberty street, New York.

THE "OTTO CYCLE GAS ENGINE," by Wm. Norris, a book described in an accompanying advertisement, will be sure to assist its readers who are interested in gas engines from any point of view.

NEW ENGLAND NOTES.

WHEELER-REFLECTOR COMPANY, 18 to 24 Washington street, Boston, have just issued a new catalogue, in which prices have been reduced on over forty styles of their reflectors, shades, etc. The discounts remain as before, thus ensuring a reduced net cost. They will be glad to send the catalogue to any address on application.

THE HOWARD & BULLOUGH AMERICAN MACHINE COMPANY, Pawtucket, R. I., have let the contract for a new building, 324 feet long by 69 feet wide. This addition will be a three-story brick building and will give over 67,000 square feet additional floor space. This three-story addition will be driven and illuminated throughout by electricity.

THE HENDEY MACHINE COMPANY, Torrington, Conn., propose to drive their new shop building by electricity. They have installed their new 100 horse-power boiler and will put in a new large engine and Eddy dynamo.

NEW YORK NOTES.

THE WARD ELECTRIC SUPPLY AND CONSTRUCTION COMPANY has been formed with a capital stock of $15,000, and is due to a consolidation of the business of Deronda Levy & Co., and O. B. Greene. The offices are at 39-41 Cortlandt street and the store rooms at 14 Cortlandt. Mr. Greene will have charge of the office management and Mr. Levy will attend to the outside construction work.

THE WESTERN ELECTRIC COMPANY was given the contract on Dec. 4, for the incandescent electric lamps and wiring of the new part of the Hotel Waldorf. It is probably the largest contract ever given in United States, or the world, for installing an isolated plant.

ZIMDARS & HUNT have been awarded the contract for wiring the Van Ingen Building, 5-7 West Twenty-ninth street, city. They report orders for automatic switches as coming in very satisfactorily indeed. Large quantities have been sold these last two weeks.

The employés of Zimdars & Hunt, 127 Fifth avenue, city, held their third annual ball Dec. 1, at Lyric Hall, Sixth avenue and Forty-second street. The hall was profusely decorated with about 500 lamps in addition to the many flags and bunting. Over the stage was a fine design of the monogram of Zimdars & Hunt, surrounded by the name of the associated employés. Above this was a large sign 30 feet long, lit up with 227 incandescent lamps forming the word "Welcome." The affair was a most enjoyable one to the 200 couples participating in the dancing which lasted until the small hours of the morning. Speeches were made by Mr. Hunt, and by the president of the Z. & H. Association, Mr. G. T. Butler, who worked indefatigably for the success of this and the previous balls.

THE MECCA of late for all the maimed and injured in New Jersey has been the Edison Decorative and Miniature Lamp Department (General Electric Company), Harrison, N. J. Although not encouraging, the visits of these unfortunates, quite a number of sufferers have journeyed to the works to have bullets and other foreign matter located in their system, it being generally known that the department, Harrison, N. J., manufacture some of the best X-ray apparatus on the market. This concern manufactures also electric signs and a large line of miniature and decorative lamps. Catalogues will be cheerfully mailed on application.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, carry a large and varied line of steel wire, suitable for springs for switches, etc. They sell also a well made and substantial lock for telephone boxes. The firm of Hammacher, Schlemmer & Co. solicit correspondence regarding their specialties.

JOHN SIMMONS COMPANY, 106-110 Center street, New York, manufacture the Excelsior railway bracket. This bracket is probably one of the most simple, practical and durable of makes now on the market. The Hercules switchboard is another one of their excellent electrical specialties. This firm will be pleased to mail circulars and prices to any address on application.

UEHLING, STEINBART & CO., Ltd., 63 Mulberry street, Newark, N. J., manufacture a highly sensitive, accurate and durable pneumatic pyrometer. It measures and records temperatures to 3,000 degrees. The demand for this pyrometer, a most ingenious invention, is steadily growing and it is fast replacing other makes in the different industries of this country. Messrs. Uehling, Steinbart & Co. report having recently placed a number of their pyrometers in several of the largest smelting furnaces in Pensylvania.

CHAS. J. BOGUE, 206 Centre street, New York City, manufactures arc lamp supplies, American system, carbon holders for all types of arc lamps, etc., and will be pleased to submit prices, etc., on application.

STUCKY & HECK ELECTRICAL MANUFACTURING COMPANY, Ltd., 35 New Jersey Railroad avenue, Newark, N. J., report running busy with a full complement of men in all branches of their work. They repair, rewind or reconstruct any make or system of armatures, lighting dynamos, power generators, motors and transformers, etc. The heads of this firm are both thoroughly practical men, which accounts for the excellent work turned out from their factory.

HAMMERSCHLAG & CO., 26 Liberty street, New York, note a marked improvement in their business, and orders are much on the increase. They manufacture X-ray outfits, small sizes of motor transformers for charging batteries, dynamo brushes of highest grade and a large variety of electrical specialties.

J. ERLANDSEN, 172 Centre street, city, has been identified for many years with the machinery trade. His specialty is the manufacture of milling cutters, aside from which he makes light machinery and tools, also special machinery and model and experimental work.

THE HINE & ROBERTSON CO., 98 Cortlandt street, New York City, have received a letter from the chief engineer of the Thorndike, of Boston, in which he says that he packed some boxes in July, 1895, with "Eureka" packing. The pump on which this packing was used has run continuously day and and night ever since, which is the equivalent of a three years' ordinary run, ten hours to the day, and the boxes are absolutely tight at the present time. This is a remarkable experience, and speaks volumes for this packing. The Hine & Robertson Co. will be glad to forward samples to any engineers communicating with them.

Department News Items will be found in advertising pages.

THE
Electrical Engineer.

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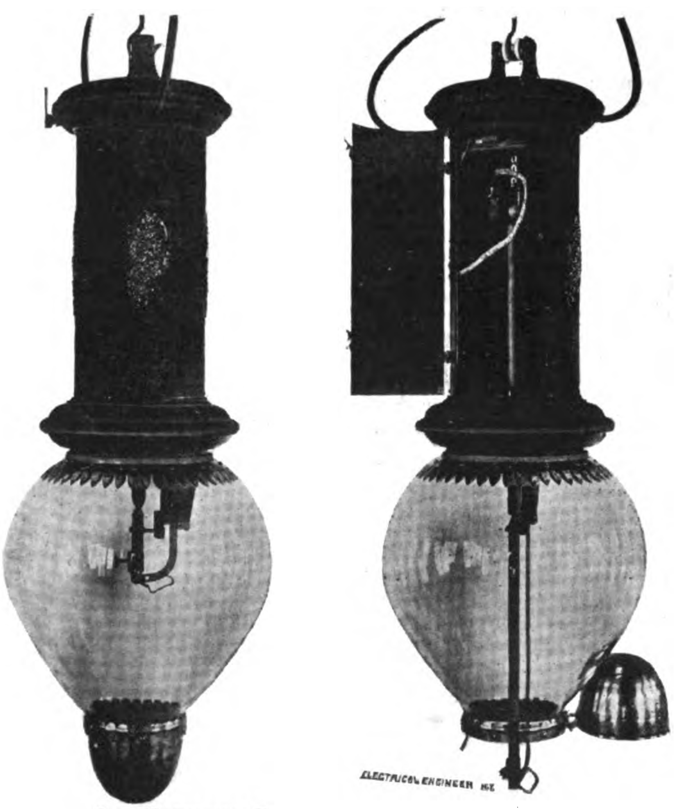
ELECTRIC LIGHTING.

THE NEW ARC LAMPS OF THE EXCELSIOR ELECTRIC CO.

SINCE arc dynamos of 150 and even 200 lights of 2,000 nominal candle power, have been successfully built, the lamp problem has assumed additional importance. The ordinary lamp takes from 3 to 5 volts to feed. When cold it draws an arc at 45 volts; but, after the shunt spools warm up, the voltage rises to 55 and even 60 volts. If the dynamo is a 150-light machine, at first it will have to generate 6,750 volts, but when the lamps get hot, it will have to generate 8,250 volts, assuming 55 volts per lamp. In addition to the inherent disadvantage due to the increased voltage, this represents an increase of 20 per cent. in the power required for the lamps.

These facts show the desirability of a lamp of approximately constant voltage. In the new lamp of the Excelsior Electric Company, shown in the accompanying engravings, this result has been accomplished, as it feeds on a variation of 1 volt, and the feeding point does not rise as the lamp gets hot.



THE EXCELSIOR ELECTRIC CO.'S NEW ARC LAMPS.

A detailed description of the distinctive features by which this result is accomplished will be found of interest.

It has been the aim, in constructing this lamp, to facilitate trimming and globe cleaning to the utmost extent possible. The lamp burns but one set of carbons in fifteen hours' service, the upper carbon being ⅝ inch diameter by 14 inches, the lower ½ inch in diameter by 12 inches long. The light remains practically in the same spot, 27 inches below the top of the lamp, the length of the lamp being 32 inches from the suspension hook to the bottom of the ash pan.

The upper carbon is clamped in a block of metal suspended from a chain which rests on a sprocket wheel and carries the lower carbon rod on its other end. The shaft of the sprocket wheel revolves in bearings formed on the end of a V-shaped casting which turns on trunnions, screwed into upright posts, extending upwards from a plate which carries the lamp mechanism.

A magnet spool in series with the carbons, strikes the arc by tilting the frame upwards when current is supplied to the lamp. The sprocket wheel shaft also carries a worm wheel which can engage the former, if pushed towards it, as the faces of both wheels are provided with teeth which will interlock. The shaft, with sprocket wheel attached, is pushed towards the worm wheel by a flat spring when current energizes the series coil, and tilts the frame upwards; but is forced back again by a lever, when the current is withdrawn and the frame has dropped downwards. In the latter position of the frame the sprocket wheel can turn freely with its shaft and will allow the carbons to come in contact.

The worm which engages the wheel is under the control of a pair of shunt spools, fitted with a self-interrupter of the current. As the arc grows longer, the spools will receive more current and the iron armature will be attracted to such an extent that it will finally open the shunt circuit. The retractile spring immediately pulls the armature back and closes the circuit again. This oscillatory motion is utilized to turn the worm step by step and causes the carbons to approach each other until the tension has been reduced sufficiently to bring the armature of the shunt magnet to rest.

As the globe of the lamp is completely closed by coming up to the lamp casing, the heat from the arc is imparted to the lamp mechanism and the shunt-magnet coils. If the latter are composed of copper wire they will have their resistance increased considerably by the heat and the passage of current thereby diminished. As the length of the arc is controlled by the shunt-magnet, it follows that it will increase as long as the heat does. To obviate this objectionable feature the shunt spools are composed of German silver, whose resistance increases but twenty one-thousandths of one per cent. for each degree Fahrenheit, while copper wire increases twenty-one-hundredths per cent.

These lamps answer for constant potential as well as constant current with but little alteration. If used for constant current they are provided with automatic cut-outs, to preserve the continuity of the circuit and also with short-circuiting switches. The lamps for constant potential have the switches arranged for opening the circuit. They do not need the automatic cut-out, but carry a German silver rheostat in an iron casting on the top of the lamp.

Opening the door of the lamp case to re-carbon the lamp does not expose the lamp mechanism to the inclemencies of the weather, but gives admission to a chamber merely in which the upper carbon holder slides up or down.

In order to place the lower carbon into its socket it is not necessary to remove the globe as the opening of the ash pan gives easy access to the hand of the trimmer for globe cleaning and re-carboning.

The globe is suspended from the lamp casing by a ring which carries three lugs engaging with three projections on the bottom of the casing. The terminal clamps for holding the ends of the line carrier or cables can be opened or closed from the outside. The lamp case does not need to be opened at all, for these operations.

INCREASE OF NEW YORK ARC LIGHTING.

At a meeting of the New York City Gas Commission recently it was decided to put in 575 additional electric lights in the city. Ninety-two of these will be above the Harlem River in the vicinity of Van Cortlandt avenue. The cost of the city's public lighting this year is $1,087,813, an increase over last year of $43,000.

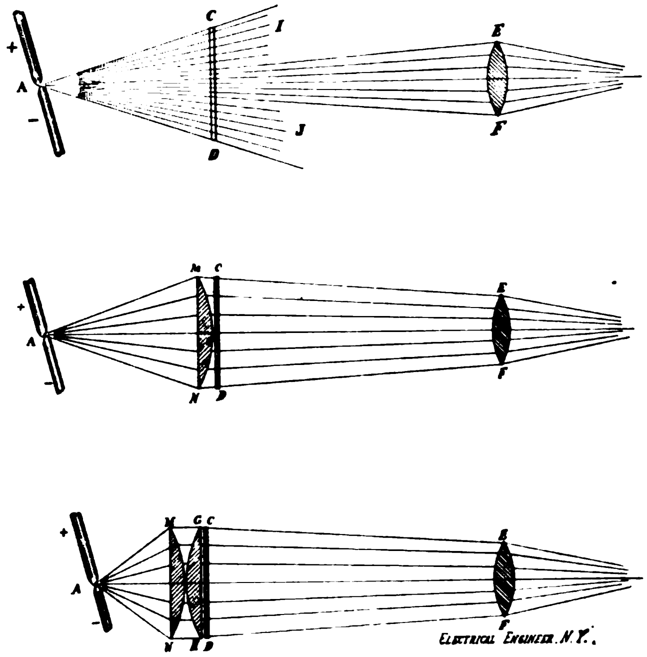
THE ELECTRIC ARC FOR LANTERN PROJECTION.—I.

BY E. P. HOPKINS.

THE projection of a concentrated light upon a surface for illustrating and other purposes, has, within the last few years, become so important that it has turned many minds towards the subject, with the usual successful results.

The first consideration is the form of an illuminant, or light, the following list being now in use: 1. Oil lamps. 2. Illuminating gas. 3. Illuminating gas used with the Welsbach burner. 4. Acetylene gas. 5. Oxy-hydrogen gas, in combination with lime or calcium. 6. The electric incandescent. 7. The electric arc.

As the electric arc so far surpasses all the other forms of light, our chief attention in this article will be given to it. I will briefly run over the main difficulties with the other forms of illumination. We will first take the oil lamp. This light is difficult to use with projection work on account of the illuminant covering a large surface. This is unavoidable if we wish to obtain a bright light, as we are bound to use one or more wicks. There is a great deficiency of white rays in the oil light, which has a very yellow or orange tinge. With the house gas, or common illuminating gas, it is difficult to make it sufficiently concentrated to give as good a light as that of the oil, but when used with the Welsbach burner, which practically is a form of incandescent light, it possesses the hue peculiar to it. This is almost twice as strong as regards white light, as most oil lamps, and when tested side by side, under exactly the same conditions, gives about twice the illumination of that produced by the best oil lamp.


FIGS. 1, 2 AND 3.

We next come to acetylene gas, which is very much superior to either of the preceding illuminants. It is extremely white, and by using three or four flames, one behind the other, we get a solid light which seems to greatly increase its brilliancy when used as a projecting illuminant. When compared with the Welsbach or the oil light, it is about four or five to one in favor of the acetylene.

Next to this gas comes the oxy-hydrogen, or lime light. This, when burning at its best, will produce from 500 to 800 candle-power, and in comparison to the acetylene gas is about seven to five.

We next come to the incandescent electric light. This, after considerable experiment, has been put into such a shape that it makes a very satisfactory illuminant for the lantern. It is necessary to have the filament of the lamp coiled up into a small spiral, not more than half an inch in diameter. In this manner we get the incandescent part concentrated into one spot, and in that way obtain the best results, as will be described later.

We next come to the arc light, which we will describe more in detail, as it is the most perfect and ideal illuminant for optical projection work.

The principle of all projections is to illuminate the object which is to be projected, as brilliantly as possible. The light radiating, transmitted or reflected from the object, is concentrated by an objective lens upon the surface where the projection is to be made. In projecting any object that itself gives out light, such, for instance, as a candle, all that is necessary is an objective lens which will concentrate the rays of light upon the screen; but when the object is transparent or opaque, the problem is different, for the subject must be illuminated so brilliantly that the rays of light passing from it to the objective must be bright enough to be distinctly seen upon the screen.

In Fig. 1 the object C D is transparent as an ordinary lantern slide through which the rays of light from the illuminant A pass to the objective E F, and so focused upon the projecting surface or screen. It will be seen that only a few rays of light passing through the center of the slide strike the lens, the others, I J, pass outside the lens, therefore the picture projected upon the screen will only be the center part of the slide C D through which the above rays of light pass.

In order to produce an equal illumination over the entire slide C D, it is necessary to have a condensing lens, shown in Fig. 2, where A is the illuminant; E F, the objective; C D, the slide; and M N is the condenser lens. This lens concentrates or refracts all the rays of light that strike it and after passing through the slide C D, they all pass through the objective lens E F, so that all parts of the slide C D are equally illuminated.

It will be noticed that if the light A is brought nearer to condenser M N, more rays or a wider angle of light will strike the lens and thus more light will be refracted through the slide C M, to the objective E F.

To produce this effect the condenser would have to be extremely short in focus; therefore, in practice it is found more convenient to use two lenses, M N and C H, which, together, produce a very short focus. When these roomssycg produce a very short focus. When these lenses are placed together the combined focus will be 3 inches.

This distance of 3 inches has been found to be a perfectly safe distance for the electric arc, when using from 7 to 18 amperes, that is, if the lenses are mounted loosely so that they can expand as they become heated. In order to allow for this expansion these condenser cells are constructed as in Figs. 4 and 5. The former is an end view of the condensers and cell that is next the light, and Fig 5 shows a section at right angles to the plane of the lenses, thus showing the springs that support the smaller lens.

In order to get the most perfect concentration of light from these lenses, it will be necessary to have the illuminant as small as possible, that is to say, to be as nearly as possible a point of light. In the oxy-hydrogen or calcium light, the illumination is spread over fully three-quarters of an inch of the lime cylinder, its entire width being half an inch; while with the electric light, when giving fully twice or three times as much illumination as that of the lime light, the surface is not more than three-sixteenths of an inch in diameter. This is at the extreme point or crater of the positive carbon giving 80 per cent. of the entire light. In order to obtain this light, and to avoid the spot of light from the negative carbon, the lamp is tilted so that the point of the positive carbon points towards the condensers. By this concentration of light, a very minute focus is obtained, so that we can bring the concentrated rays of light from the condenser to pass through an aperture not more than one-eighth of an inch in diameter. This is very necessary for all microscopical projections where one has to illuminate a large field or screen with an aperture in the lens of not more than one-sixteenth inch. The best results with the microscope are obtained by using extra condensing

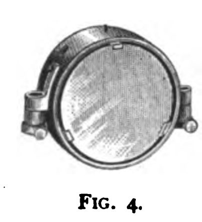


FIG. 4.


FIG. 5.

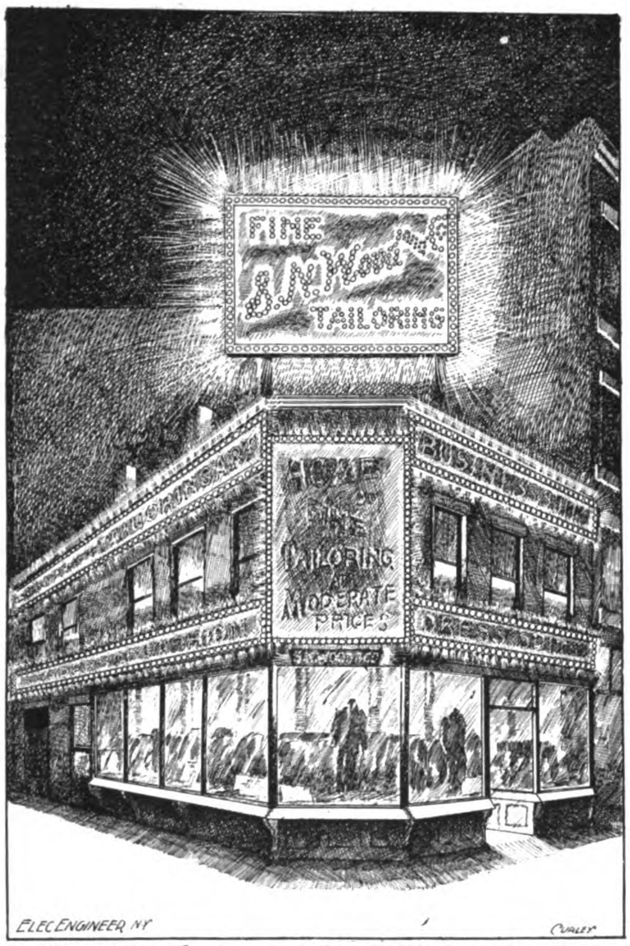
lenses, so that very little of the light is lost. With the lime-light, and all other illuminants, we cannot concentrate the light to a very small point on account of its emanating from such a large surface. It is also found, on account of the electric light emanating from such a small point, that the rays of light passing from the lenses or reflectors can be refracted or reflected so perfectly that they will extend to any distance, making the only perfect form of searchlight.

Another point of greater consideration in lantern projection is that the electric arc light, although so intensely brilliant, does not radiate much heat. Thus the illuminating power of the electric lantern is almost unlimited. Using the

electric lamp with from 18 to 20 amperes, the same condensers may be used as those for the oxy-hydrogen, that is to say, a may be used as those for the oxy-hydrogen. Great care must, of course, be taken in supporting the lens, as described above.

STORE LIGHTING EFFECTS IN NEW YORK CITY.

SEVERAL notable electric lighting effects may be found in and upon New York stores, and some of them have been illustrated in the pages of The Electrical Engineer. It may be doubted, however, whether more light has anywhere been crowded into a given store space than can be seen nightly at the establishment of S. N. Wood & Co., on upper Broadway. It is certainly the most brilliant spot in the dazzling "Tenderloin," and it would be difficult to squeeze in more lamps to the square foot of store front. The sketch herewith gives a faithful view of the store at night. The building is only two story, and hence the lighting effect is highly concentrated.



A SPECIMEN OF ILLUMINATED STORE AND SIGN, NEW YORK.

There are 300 Edison lamps of 8 candle power in the roof sign. In the large panel in the center of the front, the frames around the signs under the eaves and over the windows are 400 lamps of 8 candle power. The smaller sign below the center panel contains 96 Edison lamps of 3 candle-power, grouped in 12 series, there being thus 8 in each. Inside the building are no fewer than 300 lamps of 16 candle power and 2 arcs. It will be seen that no fewer than 1,100 lamps are employed for the illumination of this one store, the proprietors of which exhibit an enterprise upon which every electrical engineer looks with admiration. The sign work was done by Miner & Co., and the current is supplied from plant No. 1 of the Block Lighting and Power Co., corner of Thirty-first street and Broadway.

BENT CONDUIT TUBING.—On and after January 1, 1897, the Brotherhood of Electrical Workers will not connect up any bent conduit tubing except what is bent on the job. This rule will not, however, apply to what are known as standard elbows, which are regarded as coming under the ordinary run of work.

ELECTRIC TRANSPORTATION.

THE INSTITUTE DISCUSSION ON ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.—III.

BY CHARLES H. DAVIS.

The subject of "Electric Traction Under Steam Railway Conditions" can be divided into a consideration of:

1. New Roads to be built.
2. Old Steam Roads to be partially or entirely changed over.

The relative merits of the use of "Electric Traction" or "Steam Locomotive Traction" in each of the above cases can be considered under the heads:

First Cost.

Total Expenses: (1) Fixed charges. (2) Maintenance. (3) Operating expenses.

Gross receipts.

1. NEW ROADS TO BE BUILT.

First Cost.—The cost of right of way, stations, terminals, fencing, grading, ballasting and track, will be approximately the same in either system. Overhead line work, or third rail and feeder system, including track, ground and feeder returns, are not required for steam traction and their cost is an additional charge against electric traction. The cost of equipment, excluding locomotive, is in favor of steam traction, as roughly it may be considered that the motors and controlling devices, or the electric locomotive are the items making up the increase in first cost of electric traction. In the first cost of power plants we can assume buildings to be nearly the same—several round houses as against fewer power houses. The steam and electrical plants, including foundations and stack, will not only exceed the cost of locomotives and tenders per horse-power, but in the use of central electric stations a greater amount of horse-power must be installed. This is especially so when lines are very long, making it necessary to duplicate the central station, or use sub-stations, or both, before it becomes necessary to duplicate locomotives by changing them. Should the headway of trains and their weight and capacity become similar to street railway practice in large cities, then, and only then, would electric power be less in first cost than steam locomotives; if the total power required were large, this might even result in lower first cost of the entire system.

No attempt has been made to give figures, as each individual case must be studied and the difference in first cost determined; but it will in general result in favor of locomotive traction with the exception noted.

Total Expenses.—(1) Fixed Charges: These will be greater for electric traction owing to greater first cost, except in the one case mentioned above.

(2) Maintenance: This subject is too wide to be fully discussed here; but it can be assumed that permanent way, track, car bodies, trucks and other items, the same in each case, would be maintained at equal cost. It is probable that the cost of maintaining the power plant, motors, line, etc., of electric traction would exceed the cost of maintaining locomotives, tenders, etc., and that the saving due to less wear and tear on track and rolling stock in electric traction would not make up for the difference. The liability to breakdowns in electrical apparatus is greater than in steam mechanisms, thus tending to increase cost of electric traction, not only on the line, but in the power house. Should the headway be decreased, as already suggested, the comparative cost of maintenance of electric traction would decrease, resulting in favor of such traction, although it may be hard to determine the line at which the saving over locomotive traction will take place.

(3) Operating Expenses: Administrative, legal and extraordinary expenses can be considered the same; train attendance the same, except in the case of close headway and the use of motors under each car, in which case electric traction shows a decided saving. Terminal, station, signal and telegraph expenses can be considered alike in each case. The cost of coal would depend largely upon the amount of power necessary to operate a given road; for the larger the power and more frequent the trains the greater the saving by the use of electric traction. Many central stations assumed to produce a horse-power at lower cost than by smaller units really do not, mainly due to the fact that so large a part of such a station is idle many hours of the day, and, although at their maximum point of economy, they are far ahead of small units, the question at issue is not "the cost of a horse-power at the station," but "the cost of a horse-power at the rim of the driving wheels."

The cost of this last mentioned horse-power for electric traction is not only made up of station expenses, but also line expenses and electrical equipment expenses, when compared to the cost of the same horse-power produced by a steam locomotive. When these facts are taken into consideraton, it is invariably found that the controlling factor is the headway of trains; the less the headway the more surely will it pay to use electric traction, and, vice versa, so far as the cost of a horse-power at the rim of the driving wheel is concerned.

A general conclusion would be that the question of total expenses depends so largely upon each individual case that only a study of it will enable one to arrive at a reliable result; but that with light weights, small capacity and frequent service, electric traction can be operated cheaper than locomotive traction.

Gross Receipts.—The question whether the gross receipts of a given road will be affected by the use of one or the other power under discussion is a most interesting one. Experience shows that where an electric road has paralleled a steam road it has taken most of the latter's business at first, but less as time went on; and that it created a demand for intercommunication which had never existed before—the bulk of the passenger travel coming from this cause. This is interestingly shown in the arguments of Judge Hall (vice-president N. Y., N. H. & H. R. R.) and Judge Gager, of Connecticut, before the Legislature of the State at its last session. This, of course, refers to passenger receipts only. Freight receipts would not be affected by the use of one power or the other, they increasing only as the country grows and rates fall, together with better facilities. Receipts from express and mails might be materially increased by the use of electrc traction when giving more frequent service. It appears that the close headway and "leave at your door" service of electric roads are the main reasons for their induced travel. The question of how much more the travel would be increased by the use of electric traction and frequent service is problematical, for the "leave at your door" service is wanting in steam railways as they are, but why not change them? If this could be done, past experience and data would give a good basis from which to estimate future results.

The conclusions one arrives at is that for long lines, infrequent service, where freight is a large proportion of the business, and where centers of population are far apart, the steam locomotive is the only paying method of to-day, as the first cost will be less, as well as total expenses. The writer has had several opportunities of determining these facts. What development may bring to electric traction in the far future cannot be foretold.

2. OLD STEAM ROADS TO BE PARTIALLY OR ENTIRELY CHANGED OVER.

First Cost.—What has been said under "new roads" will apply, with the additional disadvantage in the use of electric traction due to the increased first cost arising from the necessity of throwing away old steam equipment, either in part or whole. In some cases this would be unnecessary, as with large systems, where existing equipment could be used on that part where electricity did not replace steam locomotives.

Total Expenses.—Remarks under "new roads" will apply; and it would, therefore, appear that unless steam railways can change the character of their service to more nearly conform to street railway practice, they will be in many cases unable to adopt electric traction in place of steam locomotives to their own profit.

Gross Receipts.—What has been said under "new roads" again applies; therefore existing steam roads, to increase their gross receipts, must give quicker and more frequent service, and must give as near as possible the "leave at your door" service.

Conclusions.—The writer believes that electric traction will be profitable to steam railway systems when some or all of the following conditions are fulfilled, depending upon the special problem to be solved:

1. Steam railway managers must avoid making the mistake which took place in the change from horse traction to electric traction, namely, of trying to reduce the first cost of changing by the use of old methods, material and equipment, which, although entirely suited to the old system, proved most unsuitable under the new conditions. The tendency is to repeat this mistake, and too much stress cannot be laid upon avoiding it. The old equipment partly made over, the old method of operating, etc., will not bring success in the use of electric traction; and if followed from necessity, would indicate the strongest argument against the change.

2. Long distance, heavy trains and infrequent service if a necessity will prevent electric traction being profitable. Therefore, where gross receipts can be increased by light trains and frequent service, and thus decrease expenses, as compared to steam locomotives, electric traction will prove profitable. One of the best examples of how this could be applied is found in the suburban service of the Pennsylvania Railroad out of Philadelphia. It is, of course, understood that electric cars can be operated over the same tracks as trains drawn by steam locomotives. A change of system requiring more frequent service for success might necessitate one or more additional tracks, which, in some cases, would delay the time when a change would be advisable.

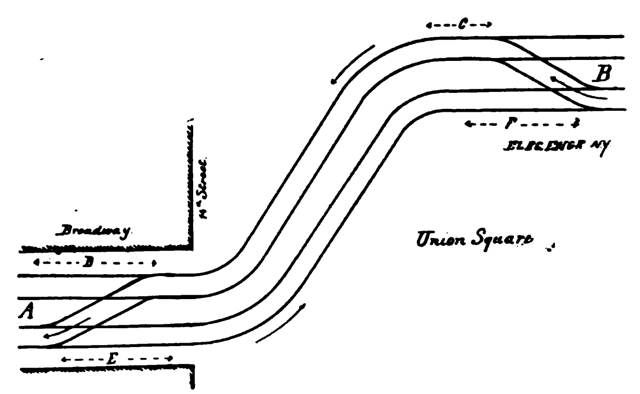
3. Steam railways, where the second condition is fulfilled, can better the results where they operate part of the system on the "leave at your door" plan. This suggestion may seem to some a radical departure, but I commend it to the careful thought of those interested.

A PROPOSED SOLUTION OF THE DEAD MAN'S CURVE PROBLEM IN NEW YORK.

BY B. J. H.

So much is being said and written about "Dead Man's Curve," at the corner of Fourteenth street and Broadway, New York, that I cannot help suggesting what appears to me a simple, practical and complete method of remedying the difficulty at comparatively small cost.

Referring to the accompanying diagram, there should be provided connecting switch tracks at A and B. One or two motors should run shuttlewise between A and B. They would go northward on the east track and southward on the west track, as indicated by the arrows. Thus they would push the northbound cars from E to F; then switch over and



DEAD MAN'S CURVE, BROADWAY AND 14TH STREET, NEW YORK.

push the southbound cars accumulated at C to D; at that point the motors would switch over again and repeat the operation continuously.

Enough ways of operating the shuttle motors at full power and controllable speed are easily available, such as the overhead, or conduit trolley, combined storage battery and underground strip, or, possibly, compressed air from a nearby supply. Even steam would be better than the present horrible work.

THE CINCINNATI HAMILTON AND DAYTON STEAM ROAD WILL ADOPT ELECTRICITY.

The Cincinnati,, Hamilton and Dayton Railroad has consummated a deal by which it becomes the owner of the street railroad lines in Middletown, Ohio. It will at once assume control, and as soon as possible the street car tracks will be connected with the tracks of the steam railway, and through cars will be operated from Middletown to Hamilton with electricity as the motive power.

The Cincinnati, Hamilton and Dayton Railroad will thus be the first to take up electricity as a motive power over its own rails. The equipment will be the most modern, and a very low schedule of fares will be adopted. This step on the part of the road is only the initiative, and will be followed by an extension of the system as rapidly as the circumstances will permit, and it will not be long before the service will be extended to Cincinnati. This will bring about a revolution in the road's suburban business, which is the heaviest of any line running out of Cincinnati. The electric service will, of course, mean more frequent cars.

THE STEEL MOTOR CO.'S NEW RAILWAY MOTORS AND CONTROLLERS.

AMONG the earliest to bring out a water and dust proof railway motor was the Steel Motor Company, of Johnstown, Pa. This company has steadily improved the design of its apparatus as suggested by continued use and is now bringing out its most recent types of 30, 40 and 60 horse-power steel motors.

The type C-3 motor, illustrated in Figs. 1 and 2, is rated at

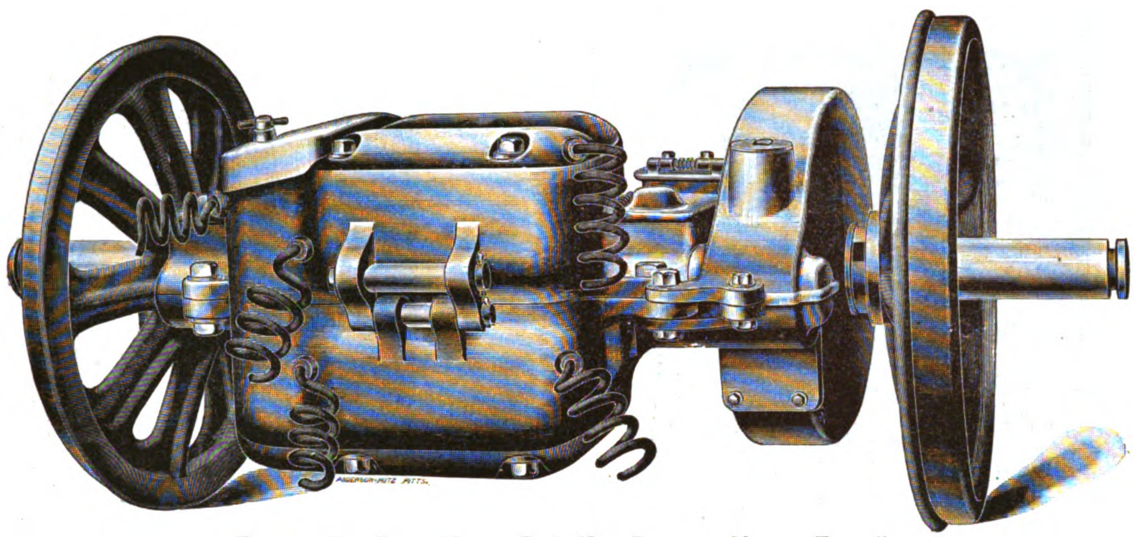


FIG. 1.—THE STEEL MOTOR CO.'S NEW RAILWAY MOTOR, TYPE C3.

30 horse-power and is designed to exert a horizontal effort or drawbar pull of 1,000 pounds, continuously, without heating, or sparking at the brushes. Much greater power can be developed for short periods of time without injury. Low cost of maintenance and accessibility of all parts are the primary objects of the design.

The frame or body of the motor is of low carbon cast steel, ensuring maximum power for minimum weight. The bearings

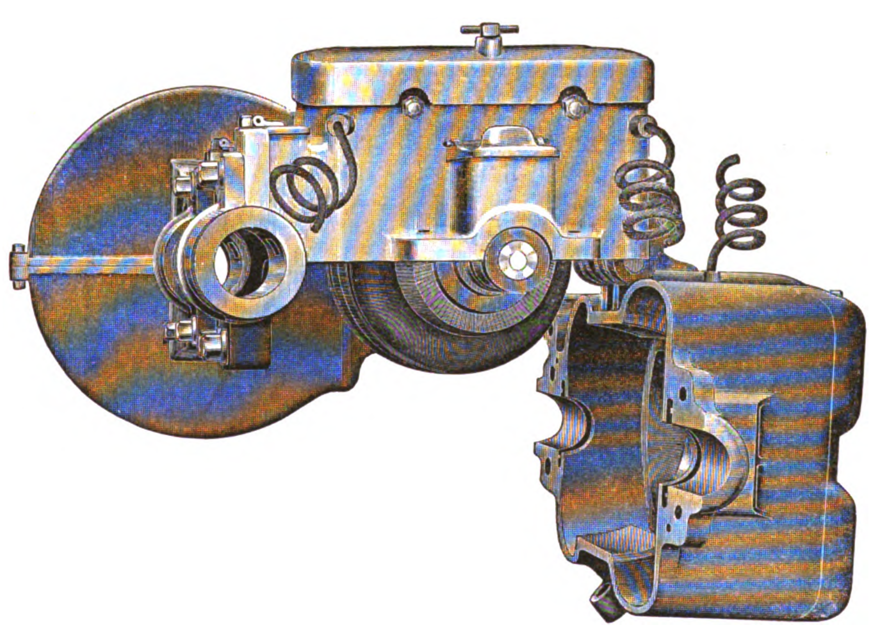


FIG. 2.—THE STEEL MOTOR CO.'S NEW RAILWAY MOTOR, TYPE C3.

for both axle and armature are contained in the same casting, ensuring perfect alignment. The frame is parted through the center and suspended so as to allow of the removal of the armature from below. The top and bottom of the motor frame are also separable and contain the upper and lower pole pieces, to which are securely attached the field coils, making it possible to remove either without disturbing any other part of the motor.

Phosphor bronze axle bearings are supplied with the motors of any desired diameter under 4¼ inches. All bearings are lubricated with grease and malleable iron covers, closed by springs, excluding all dirt from the grease pockets. Openings are provided between the armature bearings and the motor frame proper, through which all surplus grease falls to the ground. A malleable iron door or cover placed in the top of the motor over the commutator, facilitates inspection and the replacing of brushes. This opening is of ample dimensions to allow the removal of the brush-holders and yoke when desired. The motor is designed for nose suspension, the axle being relieved of all unnecessary weight, which is supported by the flexible connections with the truck.

The armature core is of the drum type, built up of thin discs of Swedish iron, with soft steel heads, and is pierced with holes parallel with the shaft for ventilation.

The shaft is of hammered steel 3⅞ inch diameter, and provided with tapered seat for both commutator and pinion. The bearings are of large diameter and great length, ensuring cool running. Flanges or collars are keyed to the shaft and run in the open spaces between the motor frame and bearings. These prevent end motion of the armature and are also an extra safeguard to prevent oil or moisture from entering the motor frame.

The armature winding consists of machine wound coils, thoroughly insulated by a special compound and a double layer of insulating material. The slots of the core are also lined with troughs of special insulating material which en-

sures their easy removal no matter how long in service. The coils are laid in the slots of the core, well below the surface. mutator, which effectually prevents the coils rising due to centrifugal force when running at excessive speeds. The coils

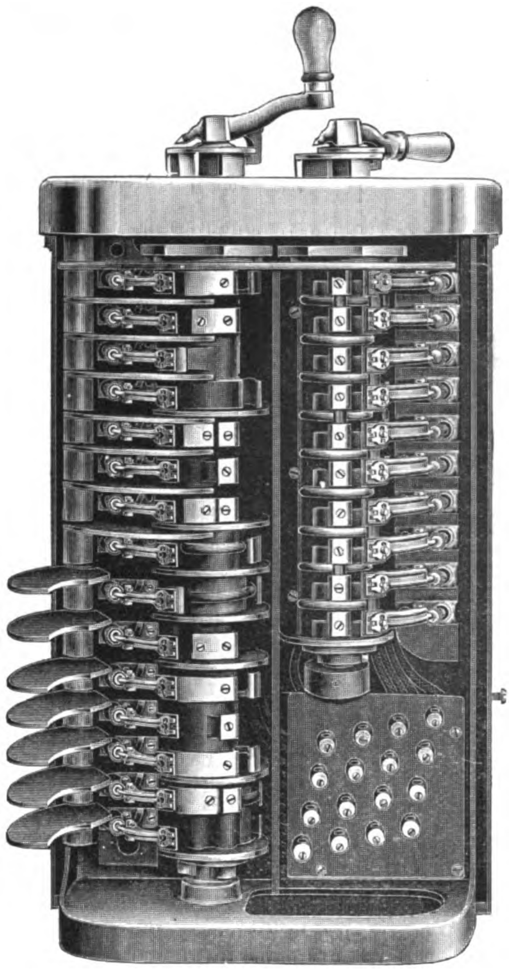


Fig. 3.—Steel Motor Co.'s Controller, Type C3.

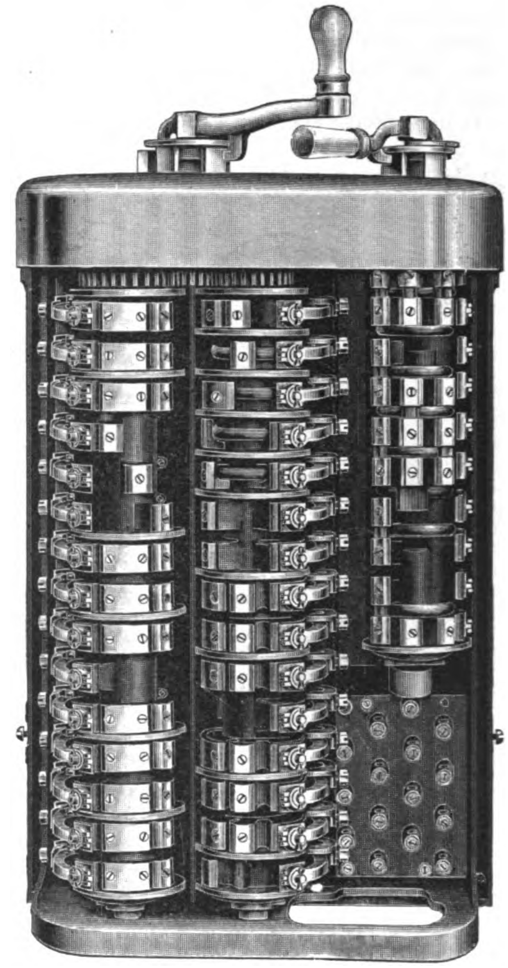


Fig. 4.—Steel Motor Co.'s Controller, Type D2.

The remainder of the slot is filled with a hard wood strip, and the whole is securely bound with German silver wire. are placed so that the heads do not interfere with the ventilation of the core.

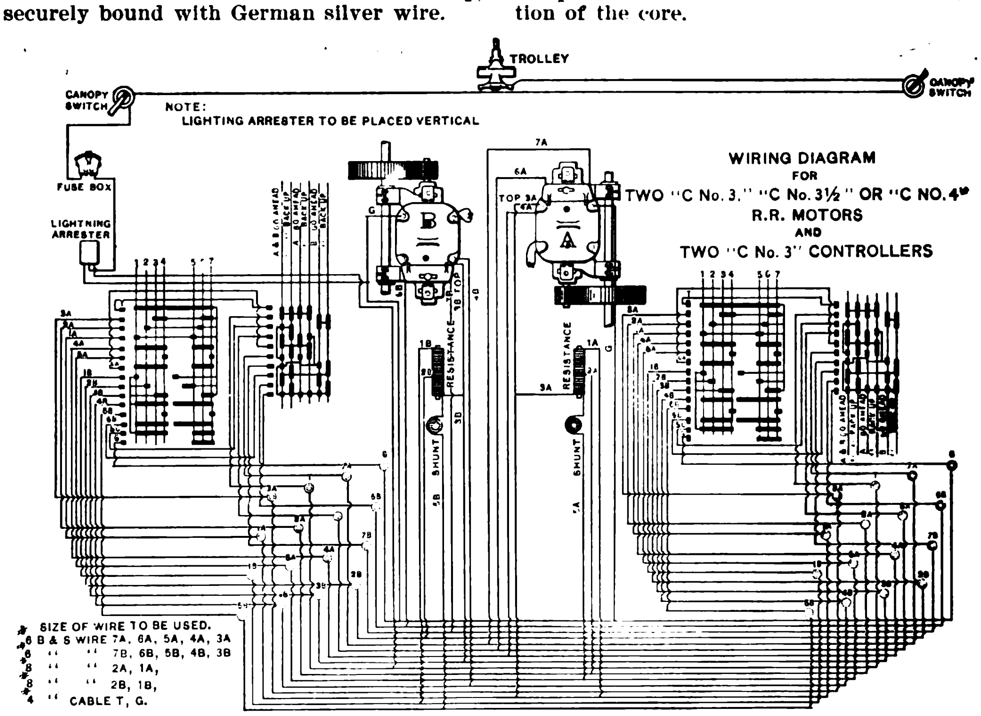


Fig. 5.—Car Wiring Diagram for Steel Motor Co.'s Motors and Controllers.

The heads of the armature are covered with canvas, thoroughly varnished to exclude moisture and dust, and a brass ventilating shield is placed on the head, opposite the commutator.

The commutator is a malleable iron shell filled with drop forged copper segments and insulated throughout with mica. The segments are locked in place by double tapered collars.

The design allows the greatest possible wear, and eliminates all possibility of the segments becoming loosened when partially worn. The leads from the armature coils to the commutator are doubly insulated by specially prepared tubing, and are soldered into slots milled in the commutator segments.

The field coils, two in number, are wound on insulated brass spools. These spools are placed upon and fastened to the upper and lower pole pieces, the poles in the horizontal planes being induced. The top and bottom of the motor, to which the field spools are fastened being detachable from the motor frame, either field coil can be removed independent of all other parts of the motor.

The brush holders are adjustable together or independently. The carbon brushes are 3½ inches long and have a bearing of 2½ inches on the commutator. The tension of the pressure spring is uniform throughout the length of feed, and the arrangement of the levers permits the hammer block to be thrown back when removing or replacing brushes.

The gears are of cast steel and the gear casing of malleable iron, accurately fitted. The special feature is the small removable section, just below the pinion, which is all it is necessary to remove when taking out the armature.

The C-3 controller, illustrated in Fig. 3, is of the series-multiple type, designed for use in connection with two motors of 25 to 50 horse-power each. The controlling cylinder consists of iron sections, placed upon an insulated shaft and insulated from each other by vulcabeston discs. Copper contacts which can be readily replaced, are fastened to these sections.

The finger board contains the stationary contacts of the company's well known type, with loose contact shoe enabling self-adjustment to any contour or inequality of cylinder, ensuring at all times the greatest possible area of contact. These fingers can be thrown back out of the way when inspecting or repairing the controller.

The distinguishing feature of this controller is the combined reversing and motor cut-out switch, which is operated by the reverse handle, the movement of which, to the points plainly marked on the index, enables both motors together, or either of them independently, to be run in either direction.

The D_2 controller, Fig. 4, is of the series-multiple type designed for use with very heavy motors, and with four motors to the car. Two controlling cylinders, moved simultaneously by means of pinion and gears, are employed, so connected that one motor or set of motors is operated by each cylinder. These cylinders are of practically the same design as the type C-3, but with contacts of much greater area and carrying capacity. This applies also to the finger contacts. Contact is broken through 28 points simultaneously, reducing the arc to a minimum.

The combined reverse and cut-out switch is the same as described in the type C-3 controller, but larger and of greater capacity. Both controllers are provided with locking devices, which prevent the motors being reversed, except by first sending the current through a proper resistance, also with indexes which plainly indicate the different points of contact.

The accompanying diagram, Fig. 5, illustrates the company's method of wiring cars for two C3, C3½, or C4 railroad motors, and two C¾ controllers.

THE GIBBS MOTOR ALARM FOR ELECTRIC CARS.

ONE of the uncertainties which harass the operators of electric cars is as to the exact time to renew the armature bearings. This is of considerable importance, for if not attended to in time, the armature drops down on to the field magnets and by friction with the pole piece causes a short circuit and burn out. Of course periodical inspection will reveal the proper time to renew bearings, but a simple device which will indicate the fact automatically, has a distinct value in itself, as well as saving the cost and time required for inspection.

An automatic motor alarm of this kind has been designed by Mr. W. A. Gibbs, of Pawtucket, R. I., and has been in successful operation for a year past on the cars of the Providence (R. I.) electric railway.

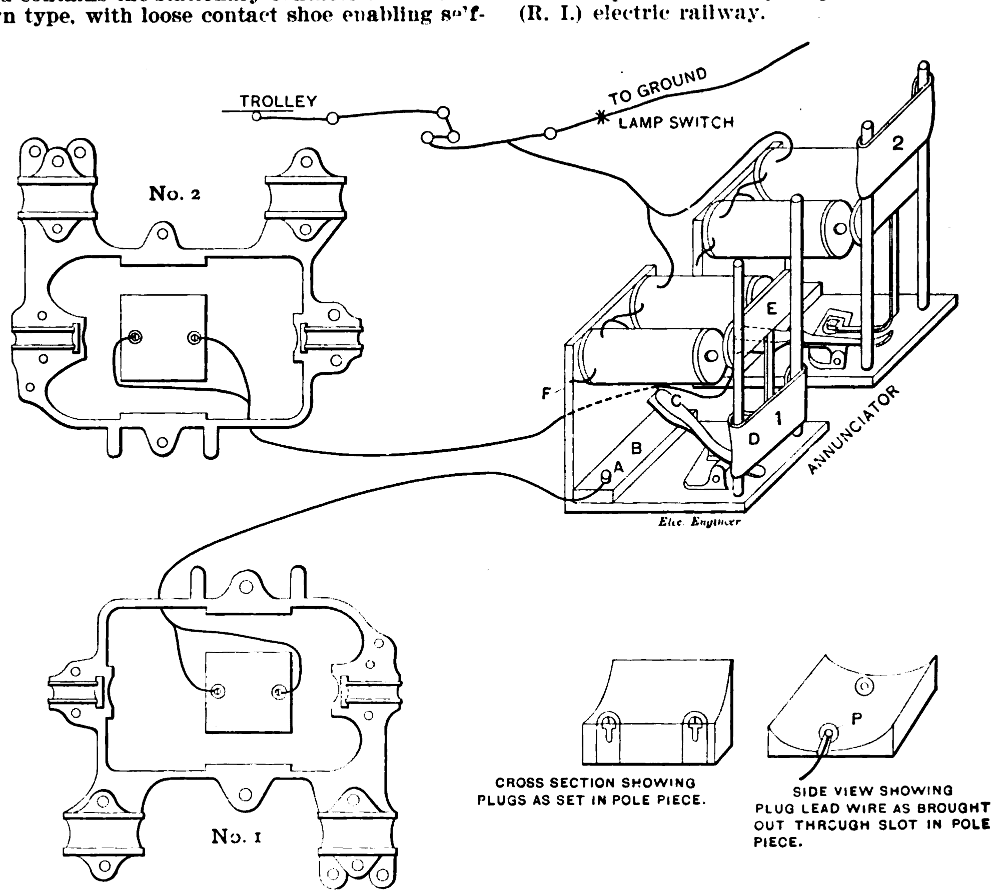


FIG. 1.—THE GIBBS MOTOR ALARM FOR TROLLEY CAR ARMATURE BEARINGS.

Our illustration, Fig. 1, shows the manner in which the Gibbs alarm is applied, Fig. 2, showing the annunciator, the drops in which, one for each motor armature, indicate, when exposed, that the bearing is worn down to its limit.

In order to obtain the necessary contact to close the annunciator circuits, plugs are inserted in the lower pole piece. These plugs, shown at P, consist of a screw set into the end of a ¾-inch round piece of fiber, so that it will come just under the surface of the fiber, about 1-32 inch.

The annunciator circuit is brought in through a hole in the side of the fiber, and clamped under the screw. The top of the screw is then covered with sealing wax, so that the contact in the plug is entirely inclosed in insulation, being thus dirt and water tight. The plug is set projecting out from the pole piece just far enough to allow the dropping armature to wear off the top down to the contact screw. The core of the

iron clad armature, or grounded band of other types, closes the circuit to ground and the annunciator drop falls. The plug simply needs to be again covered with sealing wax for another operation.

The annunciator drops are placed in a small box, Fig. 2, and the drops are only visible when down, that is, when the armature is rubbing. The wiring of the alarm circuit is clearly indicated in Fig. 1.

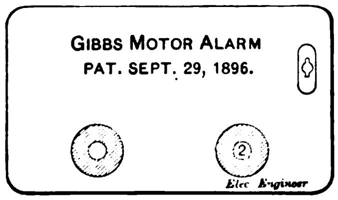
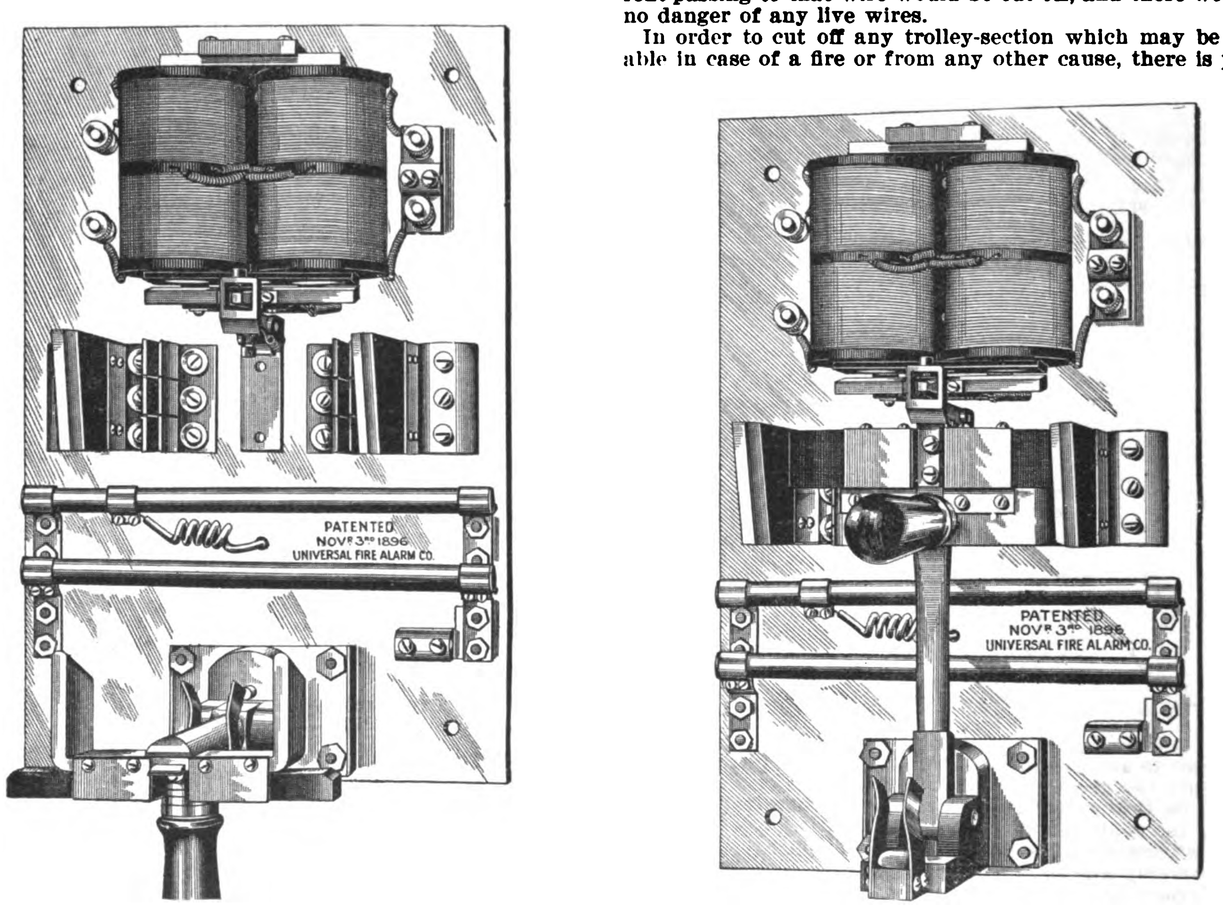


FIG. 2.—GIBBS MOTOR ALARM ANNUNCIATOR.

It must be apparent that a device of this kind not only protects the armature but also permits of a saving in the cost of bearings as the later may without fear of trouble, be run to their full wearing limit, and, as stated above, even where periodical inspections are made it will constitute an additional safeguard.

THE ROWAND AUTOMATIC CUT-OUT FOR TROLLEY WIRES.

THE danger involved in the breaking and falling of live trolley wires makes it desirable to provide a positive acting means for automatically cutting off the current from the trolley wire as soon as it parts. A highly ingenious and simple device of this nature has been designed by Mr. Lewis G. Rowand, electrician of the Universal Fire Alarm Company, of Camden, N. J., and is illustrated in its open and closed positions in the engravings, Figs. 1 and 2.



FIGS. 1 AND 2.—THE ROWAND AUTOMATIC CUT-OUT FOR TROLLEY WIRES.

The operation of the cut-out will be readily understood by an inspection of the accompanying diagram, Fig. 3. Here A is the main or trunk wire of an electric road; B, the trolley-section. The return of this trolley-section B before passing to ground passes through the electromagnet C, which has double winding, the windings being in opposite directions. The trolley-sections B pass to one of these windings. From the magnet C a wire c connects to ground.

A wire, D, also connects with the trunk line, the trolley-section B and wire D having a common connection with the trunk line A through wire d. The wire D is connected with the opposite winding of the magnet C to that to which wire B is connected. It will thus be seen that B and D are two circuits in multiple, having a connection d with the source of current supply (trunk A) common to both, each circuit having a winding of the magnet C in circuit, but the windings being opposite, so that normally the currents passing through the magnet C from the two circuits neutralize each other, and the magnet is not energized.

Upon the connection d, common to both circuits B and D, is placed a switch E, which is normally closed, being controlled by the armature c' of the magnet C, the arrangement being such that when the magnet is energized the armature acts to operate the switch to open the circuits upon the portion d. Upon both the circuits of the wires B and D are placed resistances F to prevent unnecessary current passing through the magnet.

The practical operation of this device will now be understood. Under ordinary conditions the current passes from the trunk line A both through the circuit B and circuit D. The circuit B is the trolley circuit and feeds the trolley cars. The current from both circuits B and D passes through the magnet C, but passing in opposite directions does not energize it. Now, in case the trolley-wire B, should break, the current will no longer, so far as that circuit is concerned, pass through the magnet C. The consequence is that the current from the circuit D, passing through the magnet C will energize it, and the magnet will open the switch and cut off any current passing to either the circuit B or the circuit D. As a consequence, if for any cause a trolley-wire should break, no matter how many cars there were upon the circuit, at once the current passing to that wire would be cut off, and there would be no danger of any live wires.

In order to cut off any trolley-section which may be desirable in case of a fire or from any other cause, there is placed upon either circuit B or D (as shown it is circuit D),at a point contiguous to the magnet C, a switch G, having a ground connection, which may be operated by hand, so as to short circuit the wire D to ground, which, of course, will have the effect of preventing it passing through the armature C,, and therefore, as in the case of the broken wire, the magnet C will

become energized and open the circuit to the common wire d. The same thing may be accomplished by a switch which, as shown, is short-circuited around the resistance, as shown at G'.

In many cases it is desirable that the least possible amount of current should pass to the magnet C through circuits B

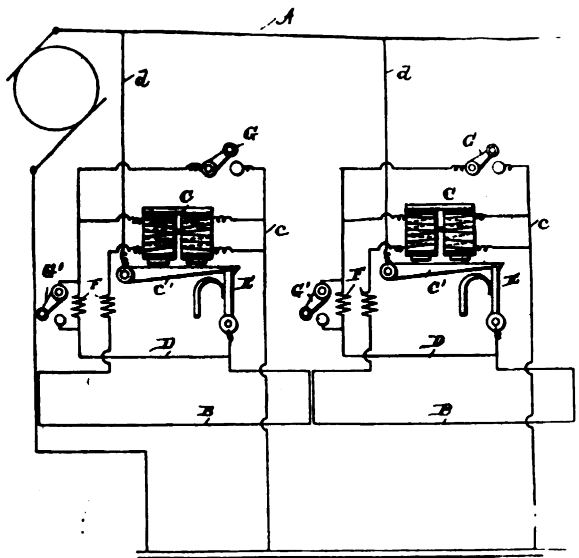


FIG. 3.—THE ROWAND AUTOMATIC CUT-OUT FOR TROLLEY CIRCUITS.

and D. This is accomplished by making the resistances F very high. In this case when the magnet is energized it would be but slightly, and hence might not act upon the armature c'. This contingency is provided for by a simple device which cuts out the resistance and sends the full current directly into the magnet which then acts with full force on the armature and opens the switch.

BOSTON STEAM LINES TO ADOPT ELECTRICITY.

A SPECIAL dispatch from Boston of Dec. 8, says: The plans of the Boston Terminal Co., which is constructing the new union station contemplates a new departure in railroading. These plans provide for the joint handling of electric and steam traffic. In some respects the new station may be considered as being an electric road station, for it will provide for the handling of the suburban traffic south of Boston, amounting to hundreds of millions of passengers annually, by means of electric trains.

The use of electricity on the Nantasket branch of the New York, New Haven and Hartford Railroad was simply an entering wedge. The system has so completely demonstrated its efficiency that next year the Dedham branch will be equipped with the third rail system, and by the time the new station is completed, it is expected that the entire suburban business of the New York, New Haven and Hartford will be handled by electric trains, the company being able to run a greater number of trains with less power than is required under the present system.

At present only the general outlines of the scheme for the extension of the electric service and its use in connection with the new Union Station are complete. But the officers of the New York, New Haven and Hartford are not only confident of the success of electricity as a motive power for suburban trains, but look forward with some confidence to the ultimate extension of the electric service to the through trains.

The New England and Old Colony roads will have the same station facilities at their disposal, and while the New England has not considered the matter seriously, some of its officers expect to see that road take advantage of the facilities which the new plans for the station provide, and use the third rail system on the New England suburban tracks.

If the experience of these roads shall warrant, there is little doubt that the Boston and Albany will take advantage of the system also, for its suburban circuit service.

B. & O. PASSENGERS CARRIED.

The total number of passengers carried on the entire system of the B. & O. R. R. for the fiscal year ending June 30, 1896, was 8,567,194, an increase of 359,586 over the corresponding period for 1895.

The total number of passengers carried one mile was 299,616,039, an increase of 11,790,117 miles.

MERIT SYSTEM ON THE CANAL AND CLAIBORNE ROAD, NEW ORLEANS.

Mr. George H. Davis, a gentleman largely interested in the Claiborne road, has established an innovation in New Orleans in the form of a civil service system among the employés. The groundwork of this plan is that all employés must go through the regular channel to secure promotion. A man is first put in as an "extra," and if he proves efficient he is given a regular position when a vacancy occurs and he is the first on the list. There is no deviation from this rule, and a man who desires to enter the employ of the company knows that no favoritism will be shown in the way of giving extra work to favorites or putting in new men in regular positions while older "extras" have to wait. Under the system there is no such thing as fining a man for any slight infractions of the rules of the company or upon the pretext of some overbearing official of the company. In lieu of fines a system of "merit" and "demerit" marks is employed. Under its operations if an employé violates a rule he is charged with a given number of "demerit" marks, according to the gravity of the offense. When he is faithful and efficient and endeavors to advance the interests of the company he is credited with "merit" marks. At intervals the "merit" and "demerit" marks are compared, and if it is found that an employé is too indifferent in his work to be a safe man to have in the employ of the company he is discharged. Under this system a steady, faithful man, knows that he is assured of steady employment and good treatment, while the company is rewarded by securing the services of the better class of workmen.

The officials of the company find that the system works very satisfactory for the road, while it also redounds to the benefit of the men. Civil service on the same lines has been tried with much success on some of the electric roads of the East, but the Claiborne management is the first to introduce it in the South. It is thought its operation will have a great tendency to create a better feeling between the road and their employés and will go far toward preventing strikes.

THE ELECTRIC PLANS OF THE LONDON "UNDERGROUND."

The Metropolitan District Railway has practically decided to adopt that plan for an express line underneath its present road from Hammersmith to "the city." A recent report of Sir Benjamin Baker to the Shareholders' Association, states that the projected line is five miles long. At the Charing Cross Station the platforms will be 63 feet below those of the present district railway, or 78 feet below the street level. The depth will be 18 feet greater at the Mansion House Station. There will be both elevators and stairways at the stations. The estimate of cost for double tunnel, shafts, permanent roadway and sidings, stations, and such land and easements as may be required, with 10 per cent. added for contingencies, is $5,000,000; for electrical installation, rolling stock, repair shops, and other equipment, and for professional charges, parliamentary and other expenses, and interest during construction, $2,250,000, or in all about $7,500,000, for the five miles of completed and equipped road. The tunnel construction is practically on the Greathead plan.

TROLLEY LINE TELEPHONE ACCIDENT IN LOS ANGELES.

A car conductor on the Los Angeles Electric Railway went to use one of the telephones along the line and call up the dispatcher, when he received a fatal shock, due to the fact that an electric lighting circuit had fallen upon the telephone wire about two miles away. It appears that the conductor in his hurry had seized the telephone by its metal contacts; otherwise he might have escaped the effects of the short circuit. The line had previously given evidence of being in trouble.

LARGE CONNECTICUT TROLLEY PROJECTS.—Various trolley railroad projects, which, as their promoters say, will be before the coming Legislature of Connecticut, either for new charters or for extensions of old ones, already involve about 100 miles of new trolley track, of which about eighty miles would parallel steam roads. From several sources come reports that the New Haven steam railroad company will try to dispense with lobby agents at the coming session, and this plan, it is stated, has led to schemes of those agents to organize a combination in favor of the electric roads.

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CONTENTS.

BOILER EFFICIENCY AND SMOKELESSNESS WITH LOW GRADE FUELS.

ELECTRIC central station requirements have put the builders of steam engines on their mettle, but the boiler makers have also been stirred to put forward their best efforts to meet the exacting requirements. Nevertheless, there would seem to be much that can be improved in this important adjunct, if we may assume as well taken the criticisms which Mr. William H. Bryan, the well-known steam expert of St. Louis, launches against general modern boiler practice. In a paper read before the Engineer's Club of St. Louis, that gentleman points out several discrepancies in the methods of boiler testing now in vogue and suggests several modifications in the code as laid down by the Committee of the American Society of Mechanical Engineers, about ten years ago. Principal among these is the expressing of the efficiency of the boiler in "equivalent evaporation per pound of coal," which is characterized as meaningless unless one knows all about the coal. Reducing to "pound combustible," is easily liable to error, particularly in low grade fuels, running high in ash and making bad clinkers, which quality largely predominates throughout the Mississippi Valley States and the West. To remedy the defect it is suggested that in every boiler trial the coal be carefully sampled and immediately submitted to chemical analysis and calorific determination. With this data at hand a ready comparison can be made as to the work actually done by the pound of coal under the boiler, and the efficiency percentage thus secured. Against the criticism that coal calorimeters are not all that they might be and that they are also liable to lead to erroneous results, Mr. Bryan urges the fact that the constant improvements being made in them must soon lead to their practical perfection.

Referring to the common necessity for boiler trials arising from boiler contracts, which include specific guarantees of performance, attention is drawn to a practice similar to that obtaining in the United States Navy contracts with shipbuilders, namely, the adding of a bonus for each fraction of the boiler performance above that specified in the contracts. In a recent bid for boilers, for example, the bids were one-third lower than they could usually be purchased in the open market, the contractors nevertheless expecting in the end to realize the full selling price, or more, by exceeding the maximum performance called for in the contract.

But what appeals to the steam user most forcibly in Mr. Bryan's paper is a tabulated statement of results of a number of boiler trials undertaken by him, nearly all made with ordinary Illinois coals. They represent the widest extremes of practice, including many badly designed and overworked boilers. Nevertheless the figures are quite interesting. They indicate, among other things, that the best improved furnaces increase the efficiency over 25 per cent. above the best common setting under a tubular boiler and about 15 per cent. under a water tube boiler. It is also shown that the best water tube boiler does over 15 per cent. better than the best return tubular with ordinary setting, the increase, however, under average conditions, being about 20 per cent.

The matter of smoke prevention was also a subject of investigation by Mr. Bryan, whose tests show that the improved furnaces have reduced the smoke on an average fully 80 per cent. He also shows that smoke averaging less than 1 per cent. is not only possible, but is being secured regularly in every day service in quite a number of large steam plants in St. Louis.

It would take us too far to discuss all the details of this most valuable and interesting paper, but we cannot forego mention of Mr. Bryan's strong advocacy of the employment of fans for producing the required draft in boiler furnaces and the consequent abandonment of tall chimneys. To quote Mr. Bryan, "it may be safely stated that in this year of our Lord, 1896, the building of tall chimneys to secure draft, simply advertises the owner's lack of familiarity with modern improvements, or his want of confidence in results easily demon-

strated." Of course, there are exceptions to this rule, where the plant is small, fuel comparatively inexpensive and money not available, or where other considerations require the gases to be discharged at considerable elevation. As a matter of fact, the most advanced electric central station engineers have long since recognized the particular advantage of forced draft and have adopted it in their practice, and when one stops to consider the variable nature of the load in lighting and railway practice, coupled with the sluggish action of a chimney, it is a matter of surprise indeed, that more general recognition has not been accorded to this important detail in steam generation. We believe, however, that for large central stations of the future, the tall chimney is out of favor.

A NEW GREAT WATER POWER DEVELOPMENT.

WE think it may be safely asserted that no art or science has served in a greater degree to bring out the latent mental forces of man than has electricity. The tremendous activity in this field for the past twenty years has resulted in the evocation of a great volume of new ideas, a goodly proportion of which have been turned to useful account and have been the basis of new industries that have added millions upon millions to the material wealth of all the civilized nations of the earth. But it is not man alone whose latent forces have been called into play by the progress of electrical development. Nature also has been drawn into the new activity and its own latent powers made available in a way and to an extent which the wildest enthusiast would hardly have dared to foretell. The utilization of the large water powers at Niagara, Lachine and elsewhere is now an old, though ever interesting story; but the announcement that a new water power of enormous proportions is about to be developed will create surprise in electrical circles. As mentioned elsewhere in this issue, a new project is well under way for tapping the St. Lawrence to the tune of a probable 200,000 horse-power. But what is most remarkable in connection with this new enterprise is the phenomenally low cost of its development. The estimate of one million dollars, for the cost of delivery of the water to wheels aggregating 100,000 horse-power, that is, at the rate of $10 per horse-power, is so low that the cost for power delivered may be expected to be placed at a correspondingly low figure. With this new power available there is little doubt that America must eventually become the center of the newer electro-chemical industry in which the cost of power enters as the principal item in the manufactured product. Already this country is exporting all the calcium carbide, for example, which the present existing plants are capable of turning out, and the demand is far in excess of the supply. This is only one of the many products which these powers will serve to produce. The alkali industries will probably be next in line and side by side with them the chlorine industry and its many derivatives. The mere mention of these few, coupled with the known enormous quantities of the alkali and chlorine products consumed throughout the world, would seem to indicate that but a comparatively short time will elapse before all the present great water power undertakings will be fully utilized. There will thus be room for all and the outlook may well stimulate search for further available powers.

THE REALITY OF BETTER TIMES.

WE are in receipt of a letter from Montana, in which the writer, at a mine, referring sarcastically to some of our recent promises of better times should this country declare for sound money and an honest dollar, says: "Please ask the editors to write me when the wave of prosperity strikes us, so that we will be prepared for it."

This compels us to advise our friend at once that the better times have actually come, and have been coming ever since election day. As to the wave striking Montana, that is another matter, for we note mention in the various financial papers of a great disinclination on the part of investors to place money in localities that voted solidly for a depreciated currency, their fear being that they might not get back as much as they loaned or invested. As to the rest of the country, and as to the electrical industry in particular, we can only say that there is an activity the like of which we have not seen in many years. In the departments of electric lighting and electric railway and power work, there is more new business in sight than at almost any other period in the whole of the past ten years. Plans are now being made and negotiations closed for new plants and extensions running well up to $100,000,000. We know of two engineers alone who are dealing with nearly $30,000,000 of new work, all to be done as soon as it can be got at. When we turn to buildings, the new electrical work is sufficiently indicated by the fact that in some three architects' offices, in New York City, about $40,000,000 of work is now on the drawing boards. Nor is everything in the future, for there is hardly an electrical concern that does not report a present gain of 5 or 10 per cent., or even more, in its trade.

If we had a stable currency, and a modest, moderate foreign policy, there would be no question as to the magnitude of the wave of prosperity now rolling in. But the wave is here, and all the harm we wish our Montana friend is that it may hit him also.

ARC LIGHTS ALONG RAILROADS.

WE have already commented on the plans of the Consolidated (New York, New Haven and Hartford) R. R. for using electric motive power on many of its branches and short lines, and it is quite in keeping that further plans should now gain publicity as to lighting stretches of the road by lines of arcs. This is not an altogether new idea, the Pennsylvania Railroad having tried it, but its general adoption by a great system is certainly new. It is said that the engineers of the Consolidated believe that four arc lights placed properly will light a mile of straight road so thoroughly as to preclude any possibility of accident from the rare causes that the block system cannot take care of. We do not know upon what experience or data this calculation is based, but venture the opinion that there would be no harm in having the lights a good deal closer, especially as it would be necessary to keep the direct beams out of the eyes of the men running the locomotives. It will be remembered that the pilots on the East River objected most strenuously to the arcs on the Brooklyn Bridge and insisted on being shielded from their direct rays, and we are inclined to think that locomotive engineers will feel just the same way. But there is no question as to the pleasant and safe travel along a road lit from one end to the other as brilliantly as a city boulevard, and in view of the double use of the power house, the cost should not run very high. As a matter of fact, the power house at Baltimore for the big tunnel locomotives does a good business in supplying and selling current for other purposes, inclusive of lighting and running street cars, and the same conditions will apply in New England, which is to-day little more than a big city strung along a railroad track.

STEALING CURRENT.

MORE than one report and inquiry of late leads us to believe that the practice of stealing current is on the increase, and that magistrates and lawyers are a little puzzled how to deal with this novel form of offense. In one case, from Germany, it is stated that the judge let off the offender on the ground that electric current is not property! While ready to admit the non-corporeal nature of the commodity, it seems to us that anything capable of being measured is capable of furnishing evidence of its own presence, or of its having been abstracted by persons to whom it does not belong. Besides, circuits must be tampered with in order to get the "juice" from them, and surely that offense is well within the scope of the law, as it exists. Gas is hardly more tangible than electricity, yet a man who burns gas not belonging to him, or cutting into pipes to get the supply, is speedily punished. Wire tappers, too, are disposed of in pretty short order, in spite of the fact that they fall far short of using the current itself, as do those who tap for the purpose of getting light and power surreptitiously. In fact, we think that any of these newer cases if properly handled would be found well within the competence of existing laws, and that convictions could be obtained. We shall, however, be glad to be advised by any of our readers as to whether specific laws on the subject exist in their respective states. If not, it might be well for the National Electric Light Association to have a law drafted, which can be taken care of by those interested in each State, and thus placed upon the statute book.

POWER TRANSMISSION.

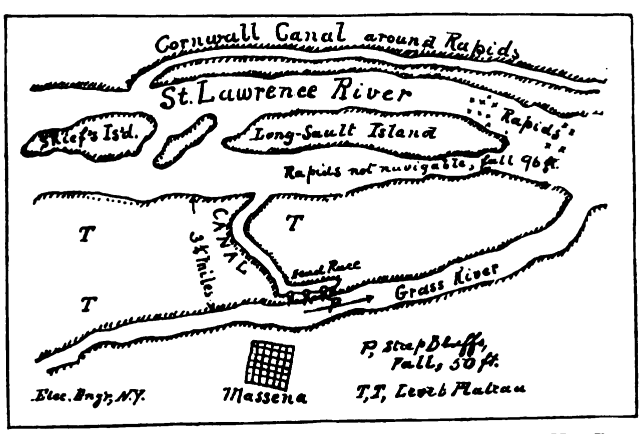
100,000, TO 200,000 H. P. TO BE DEVELOPED ELECTRICALLY AT MASSENA, N. Y.

THE Great Lakes and their outflow, the St. Lawrence River, have served as sources of power which have been developed at Sault Ste. Marie, Niagara and the Lachine Rapids, but strange as it may seem, the same water flowing in the St. Lawrence has only recently, one might say almost by accident, been discovered to be capable of delivering a still further enormous amount of power and, what is equally important, at a cost for development which is exceedingly small.

The location of this favored spot is in the town of Massena, in St. Lawrence County, close to the northern boundary of New York State, about 40 miles southwest of Montreal. At this point, as shown on the accompanying map, the Grass River, a considerable stream, flows parallel to the St. Lawrence, only three miles away and discharges into the latter, seven miles below.

In this distance the St. Lawrence falls about 100 feet over the Long Sault Rapids, but the Grass River only falls about 50 feet in this distance so that its water level at Massena is about 50 feet below that of the St. Lawrence at a point three miles due north. It is this favorable condition which has been availed of by the promoters of the enterprise.

Nature has also coupled with the above mentioned available facilities other rather remarkable advantages. Thus a level plateau, marked T, T, on the map, entirely free from rock, extends from the high bluffs on the north shore of the Grass River to the St. Lawrence. A canal only 3½ miles long will bring the St. Lawrence's water to the limestone bluff on the



MAP SHOWING PLAN OF DEVELOPMENT FOR 200,000 H. P. AT MASSENA, N. Y.

north bank of the Grass River, where it will have a sheer fall of 50 feet to the river below which is an ample and natural tail race to take the water back to the St. Lawrence. To get 100,000 horse-power all that is required is a surface canal 3½ miles long, about 200 feet wide, capable of carrying 1,000,000 cubic feet of water per minute.

Mr. John Bogart, consulting engineer of the company, has placed the cost of the canal for developing 100,000 horse-power at less than a million dollars, which means an installation cost for water power of $10 per horse-power, a figure so low that the assertion invites criticism, but the facts, it seems, cannot be disputed. Other competent engineers support Mr. Bogart's statements.

The present outlook is that the power will be nearly all used on the spot. Wood pulp mills will take a considerable share of it, but it is extremely probable that 50,000 or 75,000 horse-power will be required for the manufacture of electro-chemical products.

Lieut. F. Jarvis Patten, who is now at work designing the power plant proposes to install 10,000 horse-power dynamos connected direct to the spindles of turbines of that output, which, under the comparatively low pressure used, will involve but little difficulty.

Besides the natural advantages of the topography of the region for power purposes, the digging of the power canal will put the mills and other works at Massena in communication by water with Buffalo and the Great Lakes, while the distance by rail to New York is less than nine hours.

The promoters of this new and highly important power enterprise are Messrs. Stewart & Co., of New York.

A NEW METHOD OF SPEED CONTROL FOR ELECTRIC MOTORS.

BY PROF. W. A. ANTHONY.

AS I was unable, on account of active engagements, to be present at the last meeting of the American Institute of Electrical Engineers, when the speed control of electric motors was under discussion, I take the opportunity to present, through the columns of "The Electrical Engineer" some views of my own on the subject.

The H. Ward Leonard system is theoretically an ideal sys-

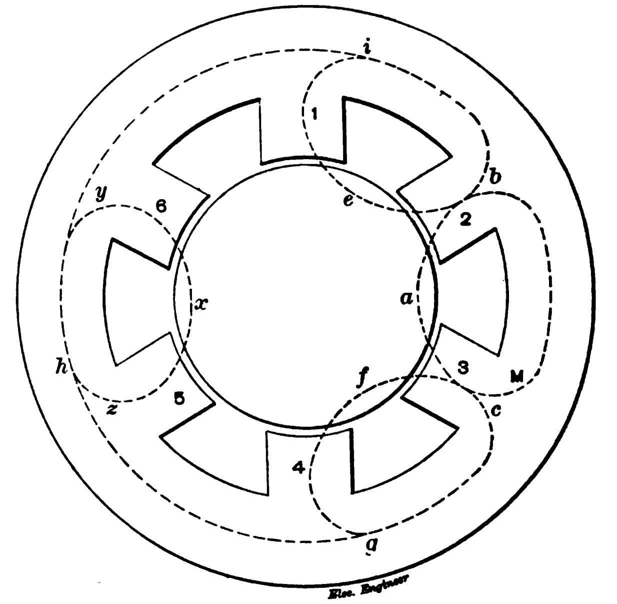


FIG. 1.

tem, giving perfect control of speed from zero to a maximum without waste of energy, but it has the disadvantage that it requires a dynamo for each motor, and that that dynamo does spark when its field is weak.

Regulation of speed by variation of field strength of the motor has the same advantage of involving no waste of energy, but it has had the disadvantage that the increase of speed that could be obtained by weakening the field, was limited to a comparatively small percentage variation, because the weak field has not the power to control the sparking at the commutator.

It is well known that the control of sparking at the commutator depends largely upon the density and stability of the magnetic "fringe" at the pole corners. It is well known, too, that this fringe disappears very rapidly as the field is weakened, and that to maintain it intact the field magneto-motive force must be kept well in excess of the armature reaction.

It occurred to me that if in a multipolar machine having a "two path" armature winding, wherein the electro-motive forces developed by the several pairs of poles were added together to make up the total e. m. f. of the machine, one

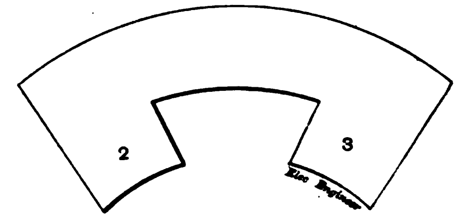


FIG. 2.

pair of poles—a north and a south—could be varied in strength without varying tne others, the magnetic fringe at the corners of the unvaried poles would remain, and a much greater variation of speed could be effected than would be possible if the field as a whole were weakened.

Let Fig. 1 represent a six-pole motor, wound as usual with a field coil on each pole. Assume that all the coils are excited. There will be an equal magnetic flux through each of the circuits a b c, e b i, f g c, etc., Fig. 1. Now suppose the

circuit through coils on pole cores 1 and 4 to be broken, and consider what will happen on the supposition that the "yoke" connecting the pole cores is very heavy and presents but a very small magnetic reluctance. The magneto-motive force tending to carry the magnetic flux through the circuits 1 and 4 no longer exists, but the lines which before went through 1 and 4 are by no means lost to 2 and 3, since they may still find their way by the path i h g of very low reluctance through the yoke. Hence, if the yoke be sufficiently heavy the poles 2 and 3 will be hardly at all diminished by cutting the coils 1 and 4 out of circuit, or even reversing them. The same is true of poles 5 and 6.

It would be easy, if necessary, to so design the machine that a b c should form one circuit and x y z another, both entirely independent of the circuit through 1 and 4. Poles 2 and 3 and 5 and 6 might, for instance, be made as separate castings, as shown in Fig. 2. Poles 1 and 4 might then be connected by yokes, which would serve also as supports for the armature bearings. Poles 2 and 3 and 5 and 6 could then be magnetically insulated from 1 and 4, so that no change produced in the magnetic strength can in any way affect the strength of the remaining poles.

It is, however, unnecessary to go to the extent of magnetically insulating the poles which are, from those which are not, to be varied. A machine made upon the ordinary plan, but having a considerably heavier connecting yoke, will serve to secure all the necessary independence between the poles.

In a six-pole machine the speed with one pair of poles cut out will be about one and a half times, and with that pair of poles reversed will be about three times the speed with all poles active, and, of course, all intermediate speeds may be obtained by gradually cutting down the current in the coils by means of resistance before cutting them out altogether and then reversing through the same resistance, which is then gradually cut out.

Machines having 10 or 14 poles will be susceptible to much wider ranges of speed variation than can be realized with one of six poles.

It is possible to apply the same method of control to multipolar machines having one common field coil for magnetizing all the poles.

It will, of course, be understood that where constant torque is required at all speeds, as is approximately the case for elevator or street car service, for running printing presses, etc., the capacity of the motor is limited by the conditions at high speed. At the low speed the capacity would be unnecessarily small, the torque being almost inversely proportional to the speed. Where constant power is required, as is approximately the case for machine tools, such as lathes, boring mills, etc., the motor would fulfill the requirements at all speeds.

The range of speed that it is possible to obtain by this method of control is certainly very much greater than has been possible by varying the field strength as a whole, and I believe it will be found an exceedingly valuable method in most cases where variable speed is required.

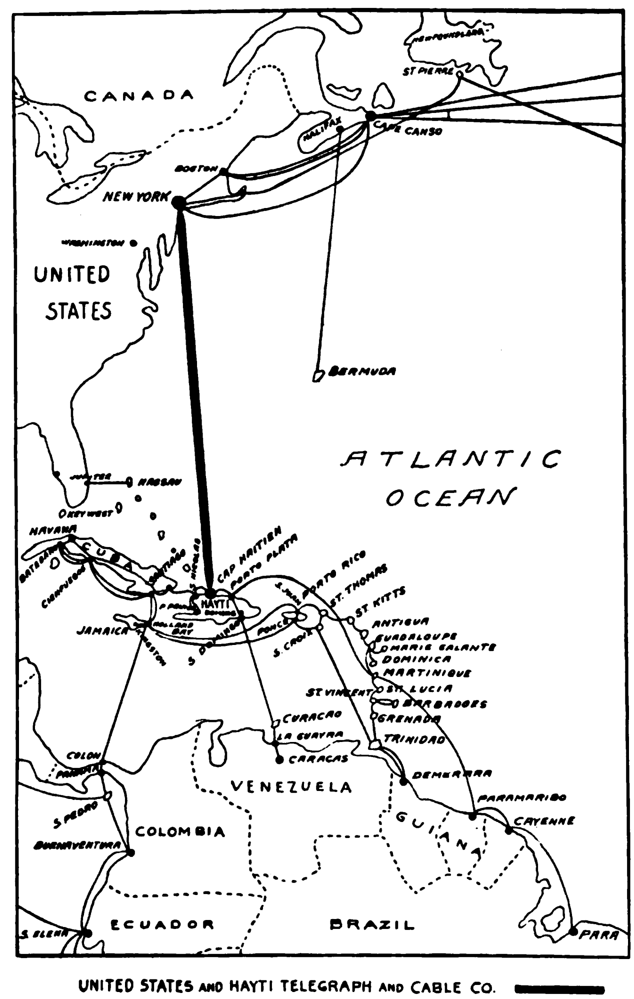
POWER TRANSMISSION AT CHEBOYGAN, MICH.

Mr. J. S. Loomis, superintendent of the Cheboygan Electric Light and Power Company, sends us some interesting data as to the power transmission there. They are now installing a 500-volt Thomson-Houston generator of 62 k. w. capacity, for day use, with the special purpose of supplying power to machine shops, printing offices, elevators, and other miscellaneous work. The station is situated on the Cheboygan River at a distance of about half a mile from the center of the district to be supplied, with power, and the dynamos are driven by water power under a head of 11 feet. The Cheboygan River, which is tapped for this purpose, is fed by the chain of small lakes extending across the upper end of the lower peninsular of Michigan from Cheboygan to Petoskey. The large body of water thus furnished acts like a self-regulating reservoir, preventing the formation of freshets during rainy seasons and making the flow of water quite uniform and constant the year round. This new power circuit will be operated in conjunction with the regular electric lighting plant, from which the company are at present supplying the city of Cheboygan with arc lights for the streets, and houses, business places, etc., with both arcs and incandescents. The apparatus is Thomson-Houston. Charges for power will be made on the flat rate system, will depend on the kind of service required, and will be made low enough to be attractive to local power users. The officers of the company are: A. McArthur, president; C. E. Mould, secretary and treasurer, and W. F. DePay, vice-president.

TELEPHONY AND TELEGRAPHY.

THE NEW CABLE TO HAYTI.

THE submarine cable between New York City and Hayti was opened to the public at midnight, Dec. 1, for the transmission of messages to and from the West Indies. The cable approaches New York by way of Coney Island and Brooklyn. The main office of the company is at 1 Broad street, where the Commercial Cable Company has its office, and messages will also be accepted at all Postal Telegraph Company offices throughout the country. Interest attaches to the enterprise from the fact that the Attorney General of the United States applied recently for an injunction to prohibit the company completing its plans, alleging that it was a cloak for a foreign company. The United States and Hayti Telegraph and Cable Company replied, proving itself a bona fide



THE NEW YORK-HAYTI CABLE.

American company, and declaring that its object was to establish a competing service and to reduce rates.

The course of the new cable is shown in the accompanying map, the original of which has kindly been made for us by Vice-President George Clapperton, of the United States and Hayti Cable Company. The various connections are indicated. It will be noted that Hayti still has to reach Jamaica by way of Cuba. The new cable is about 1,500 miles long and has a resistance of 5 ohms per knot. The rate from New York City to Mole St. Nicholas, is $1.50, or a reduction of 35 cents per word, and the same to Port au Prince, or a reduction of 60 cents. Venezuela is reached for $1.70 per word, or a reduction of 70 cents a word.

With regard to this matter, Attorney General Harmon in his report to Congress last week, said: "Knowing that Congress at its last session, had under consideration a bill to regulate the landing of foreign cables, and believing that the general sentiment favors the exclusion of companies which refuse like priv-

ileges to American companies, I deemed it my duty to direct a suit to be brought in the Southern District of New York to enjoin the consummation of the plan above mentioned. My chief design was to afford Congress an opportunity to act upon the matter before this cable should be laid. Application for a restraining order was filed, but on the showing which the Government was able to make in the brief time it had to procure evidence, the motion was denied. The case, however, is pending and will shortly be heard. I respectfully suggest for the consideration of Congress whether it would not be wise to give authority to some executive officer to grant or withhold consent to the entry of such foreign enterprises into this country on such terms and conditions as may be fixed by law. The existence of any executive authority over the subject at present is involved in doubt, and the court in which the suit was brought appeared to be somewhat doubtful as to judicial authority in the matter. The companies defendant to the suit are the Compagnie Francaise des Cables Telegraphiques, the United States and Hayti Telegraph and Cable Company, and the United States and Hayti Cable Company. Their lines, commencing in France, are intended to reach this country via South America and Hayti, in both of which and possibly also in France I am advised that they have privileges which are exclusve, at least as to American companies."

THE TELEPHONE TRUNK LINE SYSTEM IN GREAT BRITAIN.—II.

(*Concluded.*)

BY J. GAVEY.

In designing the apparatus necessary for working the Department's trunk circuits in accordance with the foregoing principles, innumerable matters of detail had necessarily to be considered. Although switch sections of uniform size and pattern have been adopted, the requirements at the smaller offices are, of course, not exactly of the same character as at the larger ones; therefore three types have been provided, respectively known as "A, "B" and "C" sections. Small offices with less than three trunks are provided with an "A" section; offices with from three to 10 trunks are fitted with "B" sections; offices with more than 10 trunks with "C" sections.

These sections differ only in the minor details of the arrangement of junction circuits, the presence or absence of transfer circuits, referred to later on, and other small points. The principle of working is the same throughout, and, if the ultimate growth of the system at an office renders it desirable to substitute a "B" for an "A," or a "C" for a "B" section, the removal of the existing section is not necessary; but the conversion can be readily effected in situ by withdrawing certain movable ebonite slip holders fitted with one class of apparatus and substituting others.

As the result of the general experience of telephonic working in this country, and after careful consideration of the whole question, it was concluded that, as an average, a fairly skilled operator should work five trunk circuits with facility and without delay. Accordingly the unit section was designed to accommodate this number.

In ordinary methods of open-circuit trunk working the switch operator first inserts a peg in the trunk jack, then rings up her correspondent by means of a separate key or press button. The reverse operations are repeated at the close of the transactions, and if several trunks are connected at intermediate points these operations have to be repeated on each trunk.

With an automatic system of signaling the insertion of the peg indicates a call at the distant office, and its withdrawal indicates the close of the transaction. These signals are automatically repeated through any number of independent trunks which for the time being may be joined up to form one circuit. The conventional signals which have been adopted by the department are the following:

Indicator needle to the right.....	Line disengaged.
" " left......	Calling.
" " vertical........	Line engaged.

The line indicator is a combination of a polarized relay, the electromagnets of which are placed horizontally with an indicator needle in front of the poles. Normally, when the switch is fully manned, the traffic is regulated by the movements of the indicator needle alone, but for slack periods and at night the relay is brought into use to repeat calling signals through a local circuit by means of a bell or buzzer. These bells are cut out of circuit by suitable switches during the day. The manner in which the signals are transmitted is illustrated in Fig. 5.

It will be observed that in its idle position the line terminates on the indicator relay, in circuit with which is a battery of six cells, known as the "permanent current line battery." A second battery of three cells, known as a "permanent current local," is joined up through a 350-ohm resistance and through the right-hand half of the relay electromagnet in such a manner as under certain conditions to reverse the polarity established by the line battery.

The distant end of the line being terminated in a similar manner, the two positive poles of the respective line batteries are normally connected to the "A" line, and the two negative poles through relays to the "B" line. Thus, if the insulation is reasonably high, no current flows from either end, and these batteries have no effect on the relay indicators. On the other hand, the local permanent current batteries send currents

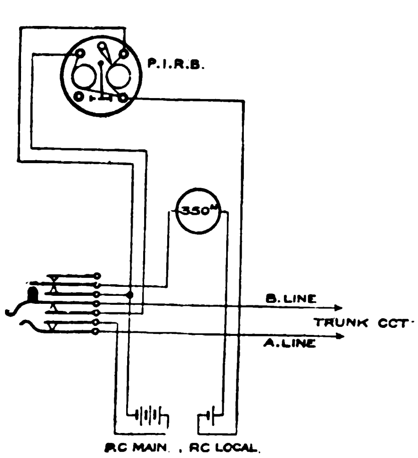


Fig. 5.

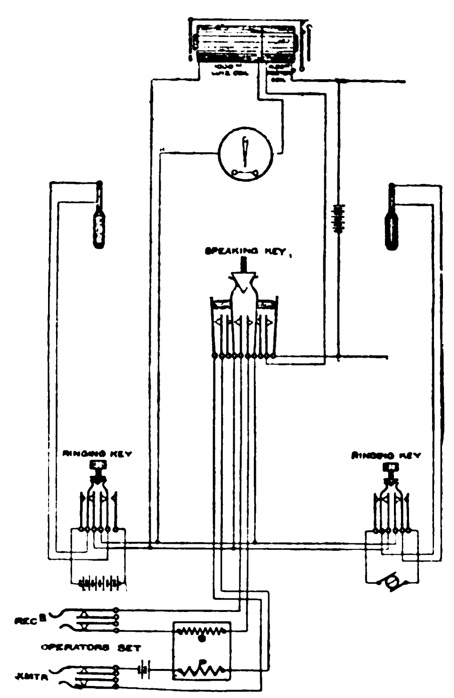


Fig. 6.

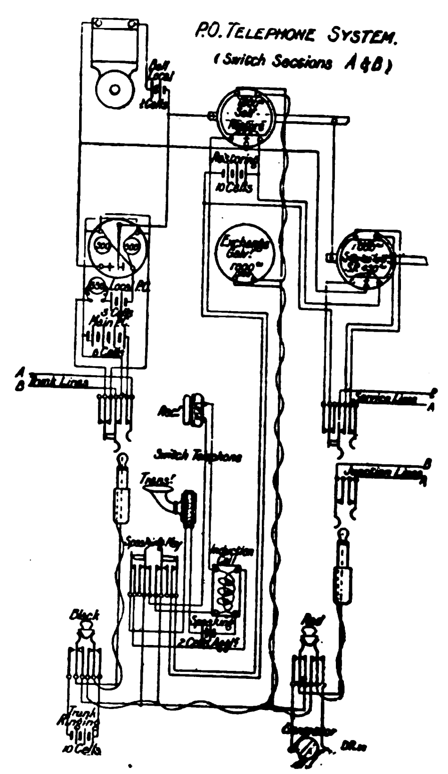


Fig. 7.

through the right-hand half of each relay electromagnet, the effect being to deflect each indicator needle to the right.

If the distant operator now inserts a peg, she disconnects her indicator relay with its opposing batteries, and substitutes the resistance of her local apparatus alone. The permanent current line battery current at the near end then flows with a reduced electromotive force due to the effect of the local battry, but in the opposite direction to the local current through the right-hand coil, and with the added electromotive force of the local battery through the left-hand coil of the relay. The polarity of the electromagnet is reversed, and the needle deflected to the left. On the insertion of a peg in the home jack to respond to the call, that indicator is also cut out of the line circuit, the local and line signalling batteries are disconnected, and the indicator needle becomes vertical.

Ringing keys are likewise provided; one set with black press buttons, being connected to batteries; the second set, with red press buttons, being joined to a small alternating dynamo, a pole changer, or a magneto ringer, according to the size of the office. The connections are illustrated in Fig. 6. The black keys are used for ringing up subscribers to postoffice exchanges, and for occasional use on the very long trunk circuits; the red keys for calling up the National Company's exchanges and subscribers.

Separate indicators are provided in the switch cords to announce the completion of the conversation, or the "ring off." There are two of these joined in series and bridged across each pair of cords, which form an electromagnetic shunt, with a resistance of 2,000 ohms. Owing to the self-induction of these shunts, they act as choking coils to the rapid vibrations of the

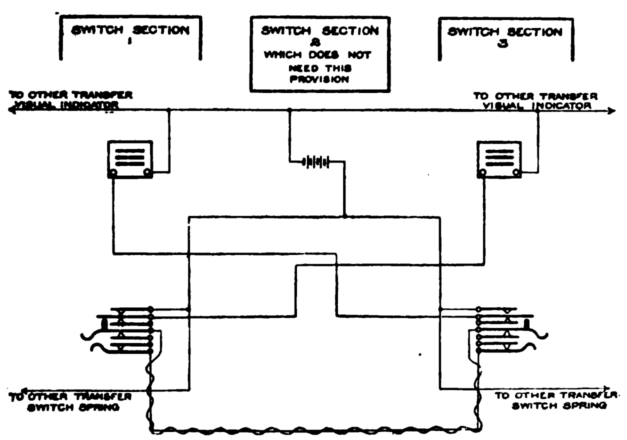


FIG. 8.

microphone, whilst responding readily to permanent currents or slow alternations. One of the indicators is a simple form of galvanometer designed to repeat the automatic signals in use on the department system, the second a Western Electric self-restoring indicator to respond to the magneto "ring off" of the company's subscribers.

When a postoffice subscriber is using a trunk circuit, on the completion of his conversation, the restoration of the telephones to their supports sends a permanent current to the exchange. This deflects the galvanometer needle described above; the exchange operators at both ends withdraw the pegs; and, if only one trunk circuit, is in use, the indicator relays, which are now brought into circuit, are both deflected to the right. If several minor trunks have been joined through at various intermediate points, the line permanent currents from the terminal offices deflect the needles of the telephone galvanometers at the intermediate points where connections have been effected. The operators, without further inquiry, withdraw the pegs, and the normal condition of things is restored.

When a trunk is in use by a subscriber to the National Telephone Company, the operators are dependent on the business-like aptitude, or otherwise, of the subscribers for the "ring-off." Should the latter fail to give the requisite turn of the handle to his magneto ringer the postoffice operators have to come into circuit at the expiration of the allotted period to inquire if the conversation is finished, before withdrawing the pegs.

Should a prompt reply not be given to an automatic call on a trunk circuit, the black keys can be brought into use to obtain attention.

Fig. 7 illustrates the connections on an "A" or "B" section.

Communication between different sections in one office to admit of joining one trunk circuit through to another can be effected in several ways. The most simple method of dealing with the problem consists in providing direct junction wires between each section and all the others; and this plan has been adopted where the sections are four or less in number, or where through trunking will, from the nature of the traffic, be infrequent. At large offices, however, the number of junctions necessary for this system would be very considerable; and, as in practice it would be necessary to limit this number, then each junction would have to be multiplied along all the sec-

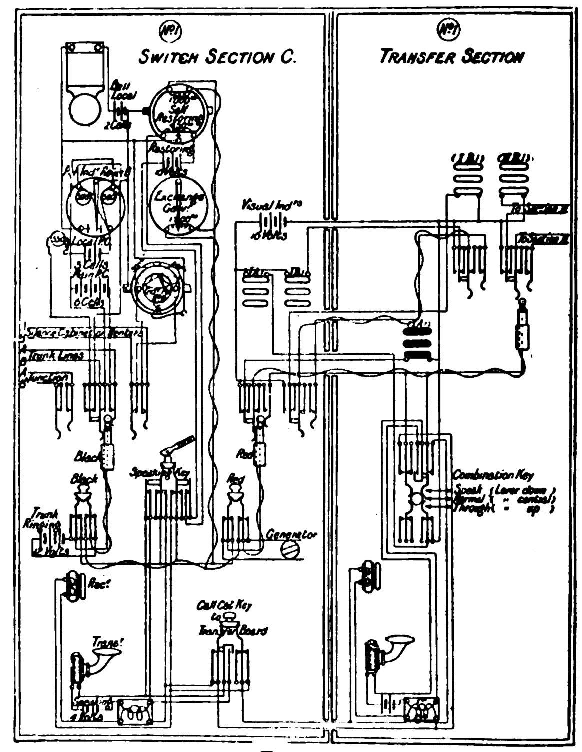


FIG. 9.

tions. To work these would involve the following operations:

First—Testing for the engaged signal.

Secondly—Ringing up the section wanted.

Thirdly—On receipt of reply, transmitting the demand; these operations in practice involving more or less delay.

To overcome these difficulties, the following modification of the divided board arrangement was introduced:

A through trunking or transfer section, sufficient to meet the requirements of 50 trunks, is provided for each 10 ordinary sections. From each section three "down" junction wires bearing the number of the section, and lettered A^1, A^2, A^3, are carried to the transfer section, where they terminate in cords and pegs. Similarly, two "up" junctions, terminated on jacks. numbered and lettered B^1, B^2, start from the transfer section to the respective switches where they terminate in jacks. The transfer switch is fitted with a three-key position for each "A" junction—

First position ....Normal
Second position ....Speaking
Third position ....Through

and both these and the jacks are provided with contacts which actuate small grid indicators, which have in practice received the somewhat inappropriate name of "visual indicators," through local circuits.

The connections for direct junctions connecting limited num-

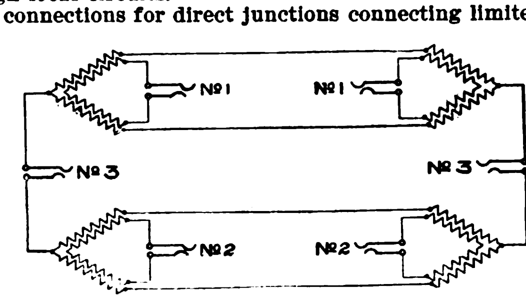


FIG. 10.

ber of sections in small offices are shown in Fig. 8, while Fig. 9 illustrates the transfer board working.

The system of duplex working that has been used by the National Telephone Company for some time has been adopted

by the department. Fig. 10 gives a diagrammatic sketch of the method of joining up. In this it will be observed that differential transformers are used, the secondaries being accurately balanced both for resistance and self-induction before they leave the workshop. No variable resistances are inserted, as any attempt to adjust in order to compensate for variations in the line would probably be a perfectly hopeless task. Under these conditions circuits of moderate length work satisfactorily, no ordinary changes in insulation resistance causing an upset of the duplex working so long as each of the arms is in sufficiently good order to work efficiently as a simple circuit. It is found, however, that if the circuits exceed a certain length it is difficult to maintain satisfactory duplex working; so that, for the present, this method is not applied to any exceeding 50 miles in length.

MISCELLANEOUS.

ELECTRICITY IN NAVAL LIFE.—XI.

BY LIEUT. B. A. FISKE, U. S. N.

POSITION FINDERS.

WHILE the appliances of modern warfare conspire to remove practical naval gunnery from the realms of chance to certainty, the art of coast defense is keeping pace, and is replying with every kind of thinkable device for increasing the rapidity and precision of fire of forts, i. e., for sinking attacking ships. Secured on firm emplacements, behind impenetrable walls, the guns and mortars of modern fortresses present the highest example of the combination of tremendous strength with refined precision. For the large calibers, the use of disappearing guns is on the increase, the gun disappearing behind the parapet after firing, to get a new charge. In order that the gun may be exposed above the parapet as short a time as possible, it is elevated on its carriage in accordance with the range signaled, and is trained in azimuth, according to the direction signaled before it is raised to fire, so that as soon as it is raised it can be immediately fired, and then by the energy of the recoil forced back at once to the loading position. Now, the determining of this range and direction is the office of a position finder. The simplest kind is the "depression position finder." Of this type there are a very great number of instruments in use in Europe, the most successful being that of Colonel Watkin, of which the English Government keeps the details a secret. In this country, that of Lieut. I. N. Lewis, United States Artillery, has proved extremely successful. It is not electric, however, and so a description would hardly belong here. The writer has endeavored to accomplish both the work of measuring and of signaling the results in instruments of this class by means similar to those employed in the range finder, in the manner hereinafter shown.

It may be pointed out here that if the position finder simply finds the distance and direction of the target from the position finder at a given instant, the people at the guns will not be benefited much, for two reasons: first, by the time that the gun can be gotten ready in accordance with any range and direction signaled, the range and direction will have changed; second, the people at the guns want to know the distance and direction of the target from their guns and not from the position finder. To remedy the first difficulty the people at the position finder do not signal to the guns what the range and direction are at that instant, but they predict what they will be thirty seconds later, so that the gun people have thirty seconds in which to lay the gun. To enable the position finder people to predict they take observations every twenty seconds, plot the exact position of the target each time on the plotting table of the position finder, and connect the various points by a line, more or less broken. A little practice enables them to thus lay down on the chart the exact track a ship is making. If the track shows that the ship has gone a certain distance in a certain direction in a certain time, it is not hard to prolong the track line so as to show where she will be two minutes later; in other words, to "predict her position." It is this predicted position that is signaled to the guns. When the ship arrives at or sufficiently near the predicted position, the signal is sent to the guns to fire. Of course if during the interval the ship suddenly changes her course and speed greatly, she will not reach the predicted position at exactly the end of two minutes. But a heavy ship cannot alter her course and speed so much in two minutes as to throw out the predicted position much, as even a rough calculation will show, especially if she is in company with other ships in a channel; and even if she could, it would be simply necessary to hold the fire until a new position were determined, which would be a matter of a few seconds only. The manner of using the position finder can be best shown by an extract from the official report on one placed at Spezia, Italy:

"The disposition of the Fiske position finder renders it possible to make rapidly a series of observations upon a target in motion, and to solve the problem of how she is going; to determine the route, the radius of the circle of turning, the speed, etc. During the recent trial at Spezia, the base line of the position finder being 104 meters long, there was determined the velocity of a torpedo-boat, which was going at a speed of 8 knots, of 10 knots, of 12 knots, maintaining a distance from the position finder ranging from 2,000 meters to 5,000 meters. There was determined at regular intervals the different points of her track, and the resulting speed deduced varied from the speed obtained on board the vessel itself by only 3 per cent. In order to give an idea of the quickness with which it is possible to fix the ship's position, and after the observers have had a certain amount of practice, it is sufficient to cite the fact that while the torpedo boat was making a complete circle of 250 meters diameter at a speed of 10.5 knots, the average distance from the position finder being 1,500 meters, there were plotted 11 successive positions. In another trial, while the boat was making a circle of 350 meters diameter, at a distance of 2,500 meters from the position finder, at the same speed her position was plotted 17 times."

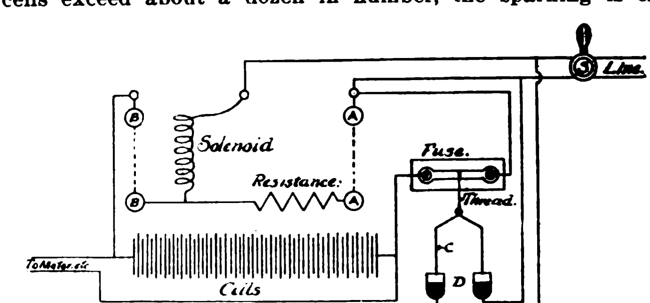
The position finder having determined the range and direction of the target from itself, it remains for the people at each gun to determine what are the range and direction from that gun. This may be done by means of tables of figures, which show for each gun what are the directions and ranges from that gun of every position that can be signaled from the position finder. But a speedier plan is offered by the instrument invented by Lieut. Rafferty, United States Artillery, called a "relocator," in which the conversion from one system of co-ordinates to the other is done mechanically. The instrument is extremely simple in construction, and (which is more important) is simple in operation, but not being electrical, its description hardly belongs here.

AUTOMATIC SWITCH FOR CHARGING ACCUMULATORS FROM AN ARC CIRCUIT.

BY EDGAR KIDWELL.

SINCE the first article under the above caption appeared in the November 11th issue of this journal, the writer has had an opportunity to subject the instrument to severer tests than were possible at first. These tests developed some defects and suggested improvements, which will now be described.

With only a few cells in circuit the design in Figs. 3 and 4 of the original article gives good results. But since the resistance is on the opposite side of the solenoid from that in the design given in Figs. 1 and 2, it follows that the potential difference causing the spark when the cells are thrown in, is that of the whole battery plus that necessary to drive the current through the resistance. In consequence, if the cells exceed about a dozen in number, the sparking is ex-



KIDWELL AUTOMATIC SWITCH FOR CHARGING ACCUMULATORS FROM ARC CIRCUITS.

cessive and the instrument cannot be considered satisfactory.

This defect is entirely obviated in the first design, here reproduced with certain additions. It is only necessary to make the resistance such that the fall of potential between its ends, when the arc current is passing through it, equals the potential difference between the terminals of the battery, where each cell is charged up to about 2.2 volts.

The writer now has 60 cells in series attached to an instrument adjusted in this manner, and the spark at A-A, when switching in the cells, is practically nil. When the number of cells is liable to vary from time to time, as in a laboratory, a variable resistance must be used for the best results. Graph-

ite resistances have not been satisfactory to the writer; hence he now uses metallic resistances entirely. The switch S should of course, be of the snap type, since a short circuiting switch, if thrown while the cells are charging, will short circuit the battery, since the automatic switch cannot act quickly enough to prevent the discharge current passing through the solenoid, thereby holding the beam down and keeping path B-B closed.

But there is always a possibility that an improper switch might be put in through mistake, or that the line wires might get crossed, or grounded, etc., and since one experience of this kind might ruin the cells, the following safety device has been used by the writer: A fuse, of capacity 50 per cent. in excess of the arc current, is put into the charging circuit, as shown. Should the cells be short-circuited by crossed wires or the switch S, etc., the automatic switch cannot act quickly enough to open B-B, but the fuse will blow out, and no harm can be done. But should the line current be turned on again before a new fuse is put in the automatic switch will act as usual, and since the charging circuit is broken, an arc will be established at A-A. To prevent this, two deep mercury cups are provided at D, and above them is a horseshoe shaped bridge piece, C, suspended from the fuse by a thread. When the fuse blows, the bridge falls, and the automatic switch, etc., is cut out, while the line circuit remains intact.

SOCIETY AND CLUB NOTES.

MEETING OF THE ELECTRICAL COMMITTEE OF THE UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

THE annual meeting of the Electrical Committee of the Underwriters' National Electric Association was held at the rooms of the National Board of Fire Underwriters, New York, on Dec. 7, 9 and 10, for the purpose of considering suggestions as to changes in the rules of the National Board for safe wiring.

There were present the following members of the committee: F. E. Cabot, Boston Board of Underwriters; C. M. Goddard, New England Insurance Exchange; Wm. A. Anderson, New York Board of Fire Underwriters; Alfred E. Braddell, Underwriters' Association of the Middle Department; E. A. Fitzgerald, Underwriters' Association of the State of New York; J. C. Forsyth, New York Board of Fire Underwriters; E. V. French, Associated Factory Mutual Insurance Companies; Wm. McDevitt, Philadelphia Fire Underwriters' Association; W. H. Merrill, Jr., Chicago Board of Underwriters; A. M. Shoen, South Eastern Tariff Association.

There were also present and acting with the committee, the following: Wm. T. Benallack, Michigan Inspection Bureau; Geo. W. Cleveland, Cleveland Board of Underwriters; James E. Cole, Boston Wire Department; J. Couilliard, New England Insurance Exchange; H. C. Cushing, Jr., New York Tariff Association; Herbert E. De Camp, Suburban Underwriters' Association; Robert C. Eden, Underwriters' Association of the Middle Department; Morton E. Eden, Underwriters' Association of the Middle Dept.; F. J. Fetter, Kansas City Board of Underwriters; Alexander Henderson, Fire Department of New York City; Frank Kitton, Buffalo Association of Fire Underwriters; George B. Lauder, New Hampshire Board of Underwriters; W. B. Lewis, Insurance Association of Providence; Wm. L. Puffer, Associated Factory Mutual Insurance Companies; Chas. R. Reynolds, Hartford Board of Underwriters; A. B. Smith, Canadian Fire Underwriters' Association; M. L. Stern, City Electrician, Denver, Colo.; R. Sweetland, New England Insurance Exchange; Geo. W. Wilson, Boston Fire Underwriters' Union.

Resolutions on the death of the late president of the association, Major C. E. Bliven, and Mr. G. F. Bottom, electrical inspector at Kansas City, Mo., were adopted.

The suggestions as to changes in rules which had been sent in on the blanks provided for the purpose, to the number of about 200, were then taken up in the order of the rules themselves, and after discussion, were acted upon; many of these suggestions emanated from the Committee on Code of the National Conference on Standard electrical rules. The changes made were not radical, being largely such as would improve or make clearer existing rules.

A number of standard tests for devices and apparatus, such as switches and cut-out blocks, were adopted.

Specifications and requirements for the use of plain iron pipe for conduit work were presented and ordered printed and submitted to the electricians present for criticism and suggestions.

In general it might be said that the nature of the suggestions offered and the changes made was such that the Underwriters' National Electric Association and its Electrical Committee may well congratulate themselves on their success in framing rules which having now been practically the only rules in use in the United States and Canada for three years, are found to need so few important changes from last year.

The secretary of the committee was also instructed in conjunction with some of the gentlemen present from Boston, to recodify the rules as amended, and submit the recodification to the committee for approval; this was believed to be important, as the various amendments made from time to time had to some extent rendered the present arrangement unsatisfactory, and it was thought that the general nature of the suggestions offered this year indicated that the rules were now so nearly perfected that this recodification was practicable.

A vote of thanks was extended to those who had interested themselves sufficiently in the rules recommended by the Association, to send in suggestions for their improvement, and especially to the Committee on Code of the National Conference on Standard Electrical Rules, for the several very pertinent suggestions offered by its members.

At the close of the meeting, the body went into committee of the whole, and voted to recommend the following elections to fill vacancies to the National Board, subject to the approval of the Executive Committee: H. C. Eddy, of Chicago, to be president; J. C. Forsyth, of New York, and E. V. French, of Boston, to fill vacancy in Electrical Committee; E. A. Fitzgerald, to be delegate to the National Convention on Standard Electrical Rules.

A code of rules and specifications for the installation of marine work, was reported by the special committee appointed last year, and ordered adopted with such changes as had been made necessary by amendments made at the present meeting.

"A STAR" PERFORMANCE BEFORE THE NEW YORK ELECTRICAL SOCIETY.

A CROWDED audience was drawn together by the subject announced for the meeting of the New York Electrical Society at Columbia College on Dec. 10, namely, the testing of a 1 horse-power dynamo and a 1 horse-power motor, in full sight of everybody. The novelty of the thing attested the ingenuity of Secretary Guy, and the merit of the performance can be gauged from the fact that it was presided over by Mr. Max Osterberg and was actually conducted by Prof. Crocker with his assistant, Mr. Sever, and Mr. C. O. Mailloux, with his assistant, Mr. Knox. These "stars" acquitted themselves brilliantly, Prof. Crocker describing what was being done and the other performers going through the successive acts and scenes with great ease and success. The motor and dynamo were mounted on the lecture room table, so arranged that they could be connected by a small brass sleeve and nut. The "drop method" was employed, and all the various readings were taken, and then the motor was submitted to a separate dynamometer test. The combination showed an efficiency of about 62 per cent. and the individual machines were therefore about 79 per cent. Additional to the descriptive talk by Prof. Crocker, and the tests, a number of lantern slides were shown illustrating forms of Prony brake and dynamometer and circuits for testing purposes; but the audience was very much of Prof. Crocker's opinion that while an electrical diagram is a deadly dull thing an electrical machine is an intensely interesting thing, and greatly preferred the tests. The motor and dynamo were kindly loaned by the Crocker-Wheeler Electric Company and instruments by the Weston Electrical Instrument Company. The dynamo delivered its current to a bank of lamps, but the pretty experiment was also carried out of turning its current back into the supply circuit.

PROGRAMME FOR THE NORTHWESTERN ELECTRICAL ASSOCIATION MEETING.

Mr. T. R. Mercein, secretary of the Northwestern Electrical Association, sends us the following programme laid out for the meeting to be held at Milwaukee on Jan. 20, and following days:

"Incandescent Lamps," by F. S. Terry, Chicago; "Protective Devices for Transformers," by H. C. Wirt, Schenectady, N. Y.; "Gaseous Fuel as a Means of Cheapening Electricity," by Nelson W. Perry, New York; "Transformers," by O. M. Ash, Elkhart, Ind.; "The Garfield Park Electrical Plant," by Forée Bain, Chicago; "Röntgen Ray Phenomena" (Illustrated), by Caryl D. Haskins, Boston; "Electrical Construction Affecting Insurance," by Geo. S. McLaren, Milwaukee; "Safety Devices for Electrical Circuits," by Prof. W. M. Stine, Chicago; "Electrical Supplies," by W. W. Low, Chicago.

ELECTRICAL WORKERS TO BE HOUSED IN.

The New York electrical contractors have decided that electrical workers will not be required to work during the winter in buildings which have not glass or sheeting to protect the workmen from the cold. The members of the Electrical Workers' Union say they will be able to do better and more work under this arrangement, as when their hands are numbed with cold it takes a day to do the work ordinarily done in several hours, and the work is not done so thoroughly.

The Electrical Workers' Union decided some time ago in favor of demanding an advance of wages from $3 to $4 a day, beginning with Jan. 1, 1897. They have now decided to notify the contractors that the demand will not be made until Jan. 1, 1898, in order that the contractors may be prepared for it.

ELECTRICAL TRADES ASSOCIATION.

The Association is doing quiet but excellent work in toning up local New York credits. At the annual meeting, held at the Astor House on Dec. 4, some 14 or 15 members were present and a permanent constitution was adopted. During the few months of work, about 150 cases have been disposed of—a remarkable record as to the economy and effectiveness of the work. It was decided to raise the initiation fee for new members to $50 after January 1, 1897. The Executive Committee consists of Messrs. Gallaher (chairman); Geddes, Thayer, Ackerman, Reed, Peck and Marshall. Similar work to that which has thus been done in New York and Philadelphia is now being done in Boston and Chicago.

LEGAL NOTES.

THE GOVERNMENT AND ITS TELEPHONE LITIGATION.

Attorney General Harmon in his annual report to Congress presented last week said:

"The suit by the Government to cancel the Berliner patent (United States vs. the American Bell Telephone Company and Emil Berliner), has recently been argued and submitted in the Supreme Court. The testimony for the Government in rebuttal, in United States vs. the Bell Telephone Company and Alexander Graham Bell, commonly called the 'Bell Telephone case,' pending in the District of Massachusetts, is almost concluded, but the sole counsel for the Government, Mr. Charles S. Whitman, of Washington, having died during the summer, I have not felt justified in employing other counsel for several reasons: First, the patents in controversy have long since expired; second, the only practical advantage which it is now possible for the Government to obtain will come from its winning the Berliner case above mentioned; if it lose that case, I see no sound reason for pursuing the other case further. Third, a very large sum has already been spent in the preparation and conduct of this case, some of the details of which were stated in the last report. The expenses of obtaining new counsel competent to finish preparing and to present the case would be very large, in view of the enormous mass of testimony already taken and the nature of the questions presented.

"In my judgment, this suit should be terminated on the best terms obtainable as to costs. I know of no reason why the Government, more than a private person, should waste money in litigation when its uselessness has become apparent.

"In view of there being now no special counsel for the Government in the case, I have made an arrangement with opposing counsel whereby no advantage will be taken of its present inaction. I again respectfully ask the direction of Congress as to the course to be followed in this case."

ACTION FOR THEFT OF CURRENT.

An unusual suit, growing out of the alleged tapping of electric wires, was heard by Magistrate Brownwell, at Reading, Pa., on Dec. 6. It was the prosecution brought against Tobacconist Samuel Hantsch and John C. Boone, who were charged with tapping the wires of the Metropolitan Electric Company used to illuminate the place of business of the former, so as to use the current to light up a show window, which did not register on the meter. C. C. Long, electrician of the company, who brought the suit, stated that some time ago it was noticed that Mr. Hantsch's bills were very small, considering the amount of light used; that he then made an inspection and found that the cluster of lights in the bulk window had been attached to the feed wire before it entered the meter, and that consequently the current used did not register. Mr. Hantsch claimed that he knew nothing about the matter, except that he thought the attachments were all right. The accused were held in $300 bail for court.

GERMAN RULING AS TO THEFT OF CURRENT.

A cable dispatch of Dec. 5 says:

A German court made an odd ruling this week in a remarkable case of larceny. A man was accused of stealing several thousand amperes of electricity by tapping a light company's wires and using it to run a dynamo (?). The court, on appeal, ruled that only a movable material object could be stolen, which electricity was not, and, therefore, the man was acquitted.

RESPONSIBILITY FOR A LIGHTNING ACCIDENT.

A rather novel suit has been instituted against the New York Telephone Company by the administrators of Lewis Edward Brown, of White Plains, who was killed by lightning in Unionville, in September last. With a party of friends Brown took shelter from the storm in a grocery. He was seated on a barrel in front of a telephone, which was attached to a post. He had jestingly remarked that he would call up the weather clerk, when there came a terrific peal of thunder and a blinding flash of lightning. Almost instantly a streak of fire issued from the telephone, and, striking Brown on the side of the neck, ran down his side to the floor. Several of the party were looking at Brown at the time, and they say they saw the lightning. The damages are placed at $20,000. Frederick W. Clark, of White Plains, is attorney for the administrators. The claim is based on the allegation that there was no ground wire attached to the telephone.

DOES A CENTRAL STATION "MANUFACTURE" CURRENT?

A case of general public interest is now before the Court of Appeals to Maryland from Frederick City, involving the exemption of manufacturing plants from municipal taxation. With a view to encourage manufacturing in the town of Frederick, an enabling act was passed by the Legislature and an ordinance was passed by the Board of Aldermen of Frederick exempting manufacturing plants from municipal taxation. Under this ordinance an electric light company claimed exemption from taxation. The tax collector of the town insisted upon the payment of taxes upon the theory that an electric light company is not a manufacturing corporation, at least in the sense contemplated by the ordinance. The case went into the Circuit Court. No other point than the one stated appears to have been raised in the pleadings, and the court decided, first, that the ordinance does not apply to an electric plant, and, second, that the enabling act was unconstitutional.

The question as to whether an electric light plant is a manufacturing plant has been treated as something of a scientific question. The contention has been made that electricity is already in existence. It is a free gift of nature and the manufacturing plant does not bring into existence anything that did not exist before. Upon this point the Court of Appeals of New York has said that electricity "is the product of capital and labor, and in this respect cannot be distinguished from ordinary manufacturing operations."

PROPRIETY OF EXHIBITS IN A TROLLEY ACCIDENT CASE.

Clara Rost, five years old, who was one of the victims of the Brooklyn trolley cars, secured judgment in the Supreme Court against the Brooklyn Heights Railroad Company for $27,500. On the trial, a physician on the witness stand exhibited the child's leg, which had been amputated, preserved in a bottle. The object was claimed to show by the physician's evidence that the electric current was still turned on when the child was run over. The Appellate Division, in Brooklyn, has just rendered a decision reversing the judgment.

Justice Hatch, who gives the opinion, after referring to the evidence as disclosing a case harrowing to the feelings in the extreme, says: "We have little difficulty, therefore, in seeing that upon the trial, where were developed all the details of so distressing a case, the emotions of the parents, and the pity excited for the little child, must have created an atmosphere tending to destroy the calm and dispassionate consideration of the real questions involved, and to prevent the jury from exercising that cool and deliberate judgment which should alone find place in a court of justice. * * * It is perfectly clear in the present case that the direct tendency of the exhibition of this mangled foot, coupled with the other considerations already noted, was to arouse the prejudice and inflame the passions of the jury to an angry resentment against the author of the misfortune." The Court holds that the verdict was excessive in amount, and that justice required the ordering of a new trial.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE.

EDITED BY MAX OSTERBERG, E. E.

Biographical:

HITTORF.—By Wm. Ostwald. On Oct. 26, '96, Wilhelm Hittorf celebrated the 50th anniversary of his graduation from the Berne University. The author thus found it appropriate to devote a few pages to a short biography of this old master and traces his principal achievements.—"Zeits. f. Elektroch.," Oct. 20, '96.

Central Stations:

LEYTON ELECTRIC LIGHTING WORKS.—An electric lighting plant where gas engines are employed which are fed from Dowson producer gas. The system at Leyton may be briefly set forth as low pressure three wire, 300 volts across the outer mains. In conjunction with it are a storage battery and motor generators. Each gas generator is designed to make gas equivalent to 100 British horse-power, and each has a cooler made of flat steel chambers, hydraulic box and coke scrubber, and sawdust scrubber. The gas holder is 20 feet in diameter, by 10 feet deep. Two small 3 horse-power vertical boilers are in the same compartment. The engines can be made to vary in speed from 160 to 200 revolutions per minute. Mr. Robinson, the consulting engineer, reports the following tests: The dynamos were run in parallel, and the current used to charge the batteries. Since the machines run slow for this purpose, the efficiency test on this occasion is unfavorable. The results of the tests which were carried on for 5 hours, are that 280 B. T. U. were generated, and the fuel consumed was 448 lbs. of anthracite and 52 lbs. of coke, giving 1.78 lbs. of fuel per unit. Taking the fuel at the full price, the cost per unit was less than .22d., which is very encouraging.—Lond. "Elec. Rev.," Nov. 20, '96.

ELECTRIC LIGHTING AT CROYDON.—This plant being of more interest in its details than in its general construction, consists essentially of the following: Three multitubular boilers, two feed pumps, a fuel economizer, three compound vertical condensing engines, each driving a 120 kilowatt alternator, and one or two dynamos with accumulators for the day load. There were to be three or four high-pressure feeders running to five transformer sub-stations in the center of the town, the power sent being 240 kilowatt at 2,000 volts. The water discharged from the condenser was weighed, with a result that at full load the consumption was found to be 17.9 lbs. per British horse-power. A plan of feeders and distributing network accompanies the article in Lond. "Elec. Rev.," Nov. 6, '96.

Dynamos and Motors:

ARMATURE REACTIONS.—By Alexander Rothert. Paper read before the Verb. Deutscher. Elektrotechn. After taking for a definition of armature reaction "the ratio between the exciting currents at no load and at some certain load, the e. m. f. being constant," the author discusses the effects in continuous and alternating current circuits. This paper having been previously referred to, it is interesting to note two letters attacking the author's method. These letters, one by Mr. Emil Giehl, of Berlin, the other by Dr. Robert Haass, appear in Lond. "Elec.," Nov. 6, '96.

BEHAVIOR OF NON-SYNCHRONOUS ALTERNATING CURRENT MOTORS WITH DIFFERENT CURVES.—By G. Roessler. The first of a series of articles in which the author briefly reviews the sine curve controversy carried on in the Lond. "Elec.," and the "Elec. World"; various types of dynamos were tested, the general result being that flat curves are preferable for motor service, except at very small loads.—"Elek. Zeits.," Nov. 12, '96.

Electro-Chemistry:

ELECTRICITY IN GOLD MINING.—Paper read before Eng's Club of Philadelphia, Oct. 17, by Dr. H. M. Chance. The writer describes the application of electricity to the extraction of gold from the ores. He points out six different methods, namely, electro-magnetic, electro-solvent, electro-amalgamating, electro-precipitating, electro-inductional and electro-smelting. Abstracted in Coll. Eng. and Met. Miner., Nov., '96.

Electric Railways:

SWITCH RUN BY ELECTRICITY.—This ingenious device consists of a double solenoid motor and a current reversing switch which is put in a small box under the switch tongue. The current is applied by means of the regular controller through an insulated section of the track near the track terminal. The device may be operated from the platform of the car. —"Elec. Jour.," Nov. 15, '96.

Electro Therapeutics:

ANTITOXIN BY ELECTROLYSIS.—M. Marmier, in a contribution to the "Annales de l'Institut Pasteur," refers to the work that has already been done on the question. He finds that continuous or alternating currents of low frequency destroy bacterial toxins. He thus disposes of the formation of antitoxin by electricity as at present recommended, for the fluid after electrolysis is perfectly different as regards its antiseptic power from the fluid before electrolysis is commenced. M. Marmier has thus disproved a pretty theory.—Lond. "Lancet," Oct. 24, '96.

Lighting:

METHODS OF CHARGING FOR ELECTRICITY.—A description of the Wright rebate indicator.—Lond. "Elec. Rev.," Nov. 6, '96. Also Am. papers of recent date.

Measurements:

ON A SATISFACTORY METHOD OF MEASURING ELECTROLYTIC CONDUCTIVITY BY MEANS OF CONTINUOUS CURRENT.—By W. Stroud and J. B. Henderson. Read before the Phys. Soc., Oct. 30, '96. Method consists in placing a balancing electrolytic cell in the arm of the Wheatstone's bridge adjacent to the arm containing the chief electrolytic cell, so that the e. m. f. of polarization in the two cells neutralize each other's effect on the galvanometer. Resistance of a solution can be determined with an accuracy of one part within two thousand. Abstracted with discussion in Lond. "Elec.," Nov. 6, '96.

METHOD FOR COMPENSATING FOR THE SELF-INDUCTION OF THE POTENTIAL COIL OF A WATTMETER.—By Ernst Danielson. Author tries to avoid the use of a condenser, for purely practical tests and arranges a set of coils, illustrated in the original article, by means of which approximate results may be quickly obtained. The total possible error, before any corrections are allowed for will be 34 per cent. For mathematical deduction see "Elek. Zeits.," Nov. 12, '96.

A NEW METHOD FOR DETERMINING POLARIZATION CAPACITY.—By C. M. Gordon. This method, based on a principle propounded by Nernst is said to be easily accomplished. Polarization capacity is compared with a condenser in an ordinary bridge arrangement. The telephone may be used in place of delicate instruments and alternating currents with known frequency are not essential. Details are given in "Zeits. f. Elektroch.," Oct. 20, '96.

Mechanical Engineering:

A REDUCING GEAR FOR ELECTRIC MOTORS.—An invention of J. MacEwan Ross, being a modification of double reduction spur gearing, which may also be used for gearing up speeds. The advantages claimed on ordinary spur gearing are: (1) driving and driven shafts are in the same line; (2) gear is compactly contained within an extension of the motor case; (3) high ratios of speed reduction are obtainable with gear wheels of comparatively small differences in diameter. An illustration of the gear appeared in Lond. "Elec.," Nov. 6, '96.

Power Transmission:

TESTS OF 150 KILOWATT PARSONS TURBO-ALTERNATOR.—Wm. D. Hunter made a set of tests showing extreme economy of steam. Consumption of steam was measured by calibrated tanks, from which the feed was drawn, and the electrical output was measured by a "Kelvin" wattmeter. The total water used per hour for about full, half and quarter load was respectively 3,484, 1.950 and 1,150 lbs., or expressed as pounds per electric horse-power per hour, the figures become 17.28, 20 and 22.01 respectively.—Lond. "Elec. Rev.," Nov. 13, '96.

Roentgen Rays:

X-RAYS.—By John Macintyre, M. B., C. M. Author, who is throat and nose specialist, discusses the different conditions of the tubes, then refers favorably to the use of the camera and in his observations on the fluorescent screen he remarks that a coarse, thick screen has given him favorable results.—Lond. "Lancet," Nov. 7, '96.

Telephony, Telegraphy, etc:

THE TELEPHONE TRUNK LINE SYSTEM IN GREAT BRITAIN.—By J. Gavey. Paper read before the Inst. of Elec. Engrs., Nov. 12, '96. A paper tracing the entire development of the system.—Lond. "Elec. Rev.," Nov. 13, '96, and subsequent issues. Elec. Engr., Dec. 9 and 16, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 1, 1896.

Alarms and Signals:—

ELECTRIC SIGNAL BELL. C. E. Scribner, Chicago, Ill., 572,220. Filed May 31. 1894.
Adapted for police call or signal systems.

RAILWAY SIGNAL APPARATUS. B. B. Morgan, Ypsilanti, Mich., 572,268. Filed May 15, 1894.
A rail connection for both rails of a single track railway placed successively, and means whereby the operation of one by a passing train disconnects the other.

ANNUNCIATOR DROP. W. Schwageman, Yonkers, N. Y., 572,378. Filed May 31, 1894.
Employs two armatures to hold the drop in position when the former are influenced by a magnet.

Batteries, Primary:—

BATTERY CELL. C. Willms, Baltimore, Md., 572,285. Filed Aug. 15, 1896.
A battery cell or vessel having a seal or stopper of caoutchouc vulcanized to its prepared end.

CELL OR BOX FOR ELECTRIC BATTERIES. J. M. Moffat, London, Eng., 572,438. Filed May 23, 1896.
A box provided with an inwardly turned lip at its upper end, a sealing lid beneath the lip, and a vent arranged in the sealing lid and opening beneath the lip, thereby preventing the escape of liquid while permitting the escape of gas.

Batteries, Secondary:—

ACCUMULATOR OR SECONDARY BATTERY. F. W. Ellermann, Vienna, Austria-Hungary, 572,198. Filed Dec. 16, 1895.
A composition for manufacturing accumulator plates consisting of litharge and sulfate of magnesium mixed into a plastic mass with liquid ammonia.

BATTERY-GRID AND MACHINE FOR PRODUCING SAME. A. F. Madden, Newark, N. J., 572,363. Filed Nov. 19, 1895.
A battery grid having shelves or partitions and a suitable supporting frame formed of an integral piece of lead, the partitions being of uniform density throughout and of different density from the supporting frame.

Conductors, Conduits and Insulators;—

INSULATED ELECTRIC CONDUCTOR. W. R. Patterson, Chicago, Ill., 572, 215. Filed Dec. 10, 1894.
Comprises a conductor immediately surrounded by a layer of wool and a covering of cotton dipped in fireproofing compound.

Distribution:—

CURRENT CONTROLLING DEVICE. J. J. Hogan, New Haven, Conn., 572,507. Filed July 24, 1896.
Means whereby a current of high potential may be utilized for purposes where battery currents are generally employed.

METHOD OF AND APPARATUS FOR TRANSFORMING ALTERNATING ELECTRIC CURRENTS. M. Hutin and M. Leblanc, Paris, France, 572,510. Filed Nov. 4, 1892.
Consists in varying the coefficient of mutual induction of the circuits of a transformer in accordance with the law of variation of the alternating currents received or delivered by the transformer.

Dynamos and Motors:—

ELECTRIC LIGHTING MECHANISM FOR BICYCLES. F. E. Magee, Brooklyn, N. Y., 572,430. Filed March 25, 1896.
A generator is driven by the rear wheel.

Electro-Metallurgy:—

ANODE FOR ELECTROLYTIC PROCESSES. H. Y. Castner, London, Eng., 572,472. Filed July 26, 1895.
A carbon electrode composed of graphitized carbon of decreased density and increased conductivity as compared with a gas retort or like carbon from which it has been produced.

ELECTRIC FURNACE. E. F. Price, Newark, N. J., 572,312. Filed July 22, 1895.
Comprises a conducting hearth forming one electrode, a range of electrodes substantially perpendicular to the hearth, a supply hopper for the material to pass around the electrodes, and means for varying the inclination of the hearth and the movement of the material thereon as it passes from one electrode to another.

MAGNETIC SEPARATOR. J. B. Hamilton, Springfield, Mass., 572,162. Filed Dec. 5, 1893.
Intended for use in extracting particles of iron from pulp.

AMALGAMATOR. W. L. & C. Brown, San Francisco, Cal., 572,353. Filed Feb. 27, 1895.

MAGNETIC ORE SEPARATOR. C. J. Reed, Orange, N. J., 572,369. Filed Sept. 3, 1891.
Comprises magnets arranged inside of a hollow cylinder, and a second surrounding hollow cylinder through which the ore is advanced longitudinally in one direction, while the tailings are discharged in another direction.

MECHANISM FOR SEPARATING MAGNETIC FROM NON-MAGNETIC SUBSTANCES. C. J. Reed, Orange, N. J., 572,370. Filed Dec. 30, 1891.
Consists of a hollow revolving drum in combination with external magnets, an internal distributer and a hopper.

Lamps and Appurtenances:—

INSULATED JOINT FOR LIGHT FIXTURES. W. McElroy, Brooklyn, N. Y., 572,124. Filed July 26, 1892.
Especially designed for combined gas and electric light fixtures.

ELECTRIC LAMP POST. J. Buckner, Boston, Mass., 572,354. Filed Dec. 26, 1895.
Comprises a tubular metallic base-section and a double step composed of metallic strips clamped upon the wooden section, and the wooden strips clamped upon the metal strips.

REGULATOR FOR INCANDESCENT ELECTRIC LAMPS. W. Hawker, Montreal, Can., 572,421. Filed May 29, 1896.
Details of construction.

ELECTRIC LAMP. F. E. Magee, Brooklyn, N. Y., 572,431. Filed March 25, 1896.
Adapted for use on bicycles.

Measurement:—

VOLTMETER. A. A. Simonds, Dayton, Ohio, 572,380. Filed March 20, 1896.
Provided with a water jacket whereby the temperature of the coil is kept permanent.

Miscellaneous:

ELECTRIC SIGN. W. Connell, Pittsburg, Pa., 572,158. Filed March 10, 1896.
Means by which the position of letters or figures may be shifted at pleasure from a distant point.

ELECTRIC ROLLER FOR THERAPEUTICAL AND MASSAGE PURPOSES. J. W. Gibbs, New York, 572,431. Filed Sept. 22, 1896.

ELECTRIC TOWING APPARATUS. A. E. Schatz, New York, 572,377. Filed Jan. 19, 1893.
A motor adapted to run upon a track adjacent to a water way and means for connecting same to a boat whereby the latter may be towed.

ELECTRIC HEATER. B. E. Baker, New Britain, Conn., 572,467. Filed June 4, 1894.
Sad-iron.

ELECTRIC CLOCK. J. A. Schulte, Arcadia, Iowa, 572,131. Filed Aug. 12, 1895.
Comprises a primary clock, a generator, a series of electrically actuated clocks connected together by a single circuit, each having a setting circuit successively closed and each having a holding circuit, all such circuits being in series when current is traversing them.

ELECTRIC DOOR OPENING APPARATUS. O. H. Hicks and R. F. Troy, Chicago, Ill., 572,301. Filed Jan. 28, 1896.
Details of construction.

ELECTRIC STEAM AND GAS ENGINE. F. A. Rich, Telluride, Colo. Filed May 9, 1896.
A vessel having an inlet and outlet pipes and partially filled with a liquid, a steam generator supported by the liquid, a heating coil within the vessel, and electric conductor connecting the heating coil and steam generator with the source of electricity, and means for alternately opening and closing the electric circuit.

Railways and Appliances:—

COMBINED ELECTRIC AND GRAVITY PLEASURE RAILWAY. J. A. Griffiths, Philadelphia, Pa., 572,111. Filed April 7, 1896.
Employs electric motors on up grades.

ELECTRICALLY ACTUATED RAILWAY SWITCH. R. M. Hunter, Philadelphia, Pa., 572,169. Filed July 25, 1894.
Means whereby the motorman may throw the switch in advance of the car's approach.

Switches, Cut-Outs, Etc:—

ELECTRIC SWITCH. C. B. Sterling, New York, 572,319. Filed June 13, 1895.
Snap switch.

Telephones:—

EARPIECE FOR TELEPHONE RECEIVERS. D. C. Farrington, Washington, D. C., 572,108. Filed April 3, 1896.
Comprises an earpiece of a telephone receiver, a cushion detachably seated in the face thereof, and a detachable nipple communicating with the auditory passage through the earpiece and cushion and adapted to hold the cushion in its seat.

TELEPHONE TRANSMITTER. F. A. Ray, Boston, Mass., 572,182. Filed, Oct. 23, 1895.
A diaphragm is mounted between cushion rings of carbon.

TELEPHONE TRANSMITTER. L. D. Appleton, Waynesborough, Va., 572,188. Filed March 19, 1896.
Comprises a diaphragm, an electrode moving therewith, a second electrode fixed between the diaphragm and the first electrode, and a granular conducting mass interposed between the electrodes.

NEEDLE PLUG TEST SYSTEM FOR MULTIPLE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 572,218. Filed June 1, 1888.
Means for determining at one board whether a line called for is in use at another switchboard.

CORD SWITCH FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 572,219. Filed May 14, 1894.
Comprises a socket and a resting plug resting therein, a lever of the first class having one extremity bearing upon the side of the plug, switch-contacts actuated by the other extremity of the lever, and circuit connections with the switch-contacts.

TELEPHONE EXCHANGE SYSTEM. C. E. Scribner, Chicago, Ill., 572,221. Filed Oct. 16, 1894.
Means to prevent the connection of more than one line at a time with the operator's telephone.

TELEPHONE CIRCUIT. C. E. Scribner, Chicago, Ill., 572,222. Filed Aug. 1, 1895.
Comprises an inductive resistance in shunt to the telephone, and an electro-magnetic responsive instrument requiring for its operation a current greater than the maximum resistance of the transmitter would permit.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., and F. B. McBerty, Downer's Grove, Ill., 572,223. Filed June 6, 1894.
Comprises a connecting plug, an operator's telephone, an electromagnet connected with a circuit of the plug adapted to be closed during the insertion of the plug in a spring jack, and switching mechanism actuated by the magnet to interrupt the circuit of the telephone.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOV. 17, 1896.

Alarms and Signals:—

ELEVATOR SIGNAL APPARATUS. S. B. Opdyke, Jr., Philadelphia, Pa., 572,561. Filed April 24, 1894.
Means for signaling car to stop at landings.

ELEVATOR SIGNAL MECHANISM. S. B. Opdyke, Jr., Philadelphia, Pa., 572,562. Filed Oct. 8, 1894.
Similar to above.

ELEVATOR SIGNAL APPARATUS. S. B. Opdyke, Jr., 572,563. Filed Dec. 18, 1894.
Similar to above.

ELECTRIC SIGNAL APPARATUS. G. Knowles, Milwaukee, Wis., 572,607. Filed July 19, 1895.
Means to utilize the same electric circuit or generator for operating the signal transmitting mechanism as is employed for the transmission of signals.

Electro-Chemistry:—

PROCESS OF MANUFACTURING PHOSPHATES OF ALKALIES. H. Albert, Biebrich, Germany, 572,512. Filed Jan. 28, 1896.
Consists in forming bath of phosphoric acid and a bath of the soluble salts of the alkali metals, associating the two baths together in an electrical circuit, the baths being separated by a porous diaphragm and thereupon electrolysing the combined baths by passing a current of electricity through them, whereby a mono, di or tribasic phosphate of alkali employed is produced at the cathode.

Electric Furnaces and Heating:—

ELECTRIC FURNACE. J. E. Hewes, Philadelphia, Pa., 572,636. Filed Sept. 8, 1896.
Designed for the manufacture of calcium carbide.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. C. Goodyear, Jr., New York, 572,539. Filed Oct. 16, 1895.
Hand feed arc lamp for either alternating or direct currents.
ELECTRIC ARC LAMP. T. Spencer and C. Toerring, Jr., Philadelphia, Pa., 572,777. Filed May 6, 1896.
Feed mechanism.
ELECTRIC LAMP. L. A. Jackson, New York, 572,805. Filed July 25, 1896.
Bicycle lamp.

Miscellaneous:—

ELECTRIC ELEVATOR. John P. Casey, Bloomsburg, Pa., 572,525. Filed Aug. 23, 1894.
Details of construction.

Railways and Appliances:—

RAIL BOND. I. B. Walker and L. G. Nilson, Sioux City, Ia., 572,668. Filed Sept. 9, 1896.
Consists of a wire or strip of metal having terminal lugs, with a V-shaped portion cut away.
ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 572,706. Filed Nov. 4, 1896.
The strength of the field magnets is controlled by a gravity-influenced bar, so as to maintain the speed constant.
TROLLEY FOR ELECTRIC RAILWAYS. H. A. Seymour, Washington, D. C., 572,933. Filed June 15, 1896.
Consists of an elongated support attached to the upper end of the pole, and a trolley wheel adapted to travel laterally on the support.
SUPPORT FOR TROLLEY WHEELS. C. F. L. Orth, New York, 572,940. Filed April 16, 1896.
Device for keeping the trolley wheel upon the conductor wire.
ELECTRIC SWITCH. Charles H. Haberer, Louisville, Ky., 572,929. Filed Feb. 27, 1896.
Designed to be operated by an approaching car.

Regulation:—

SYSTEM OF AUTOMATIC ELECTRIC REGULATION. W. L. Bliss, New York, 572,627. Filed May 6, 1896.
Employs storage batteries to maintain a constant potential.
REGULATING ELECTRIC MOTORS. H. W. Leonard, New York, 572,903. Filed June 24, 1892.
A source of supply for the motor, and a regulating device in series with the armature of the motor and acting sometimes to return energy to the line.

Switches, Cut-Outs, Etc.

ELECTRIC SWITCHBOARD. E. A. Fordyce, Chicago, Ill., 572,748. Filed Nov. 4, 1893.
Comprises a switchboard having a plurality of keys, each provided with a contact piece, a controlling magnet having a connector common to the series and a plurality of electrical circuits corresponding to the several keys, each including its respective key and the controlling magnet and a circuit controller for each branch circuit.
AUTOMATIC CIRCUIT CLOSING DEVICE FOR GALVANIC BATTERIES. J. D. Holmes and W. L. Heath, St. Louis, Mo., 572,754. Filed Oct. 1, 1896.
Comprises circuit closing devices actuated by the rise and fall of the fluid of the cells for closing a metallic circuit through any cell when the fluid in it has fallen to a predetermined level.
AUTOMATIC CIRCUIT CLOSER. E. C. Williams, Clarksville, Tenn., 572,923. Filed May 9, 1896.
Adapted for telegraph and other closed circuit work.

Telegraphs:—

TELEGRAPH SYSTEM. B. F. Merritt, Orange, N. J., and J. M. Joy, New York, 572,609. Filed June 27, 1896.
Means to operate the line of a "Printing telegraph" system by one battery.
TELEGRAPHY. I. Kitsee, Philadelphia, Pa., 572,639. Filed Feb. 20, 1896.
Duplex system of telegraphy with alternating impulses.
PRINTING TELEGRAPH. L. Kamm, London, England, 572,760. Filed Dec. 30, 1895.
Apparatus to act as transmitter and receiver.

Telephones:—

TELEPHONE TRANSMITTER. R. L. Hunter and H. B. Higgins, Minneapolis, Minn., 572,756. Filed May 23, 1896.
Comprises a fixed base, line terminals, transmitter and interlocking means for securing the transmitter to the base and electrically connecting it with the terminals.
TELEPHONIC APPARATUS. C. J. Schwarze, Adrian, Mich., 572,775. Filed June 30, 1896.
An instrument which may be used as a transmitter, receiver and for signal purposes.
TELEPHONE EXCHANGE. M. F. Hill, Cambridge, Mass., 272,801. Filed July 16, 1895.
The combination of an answering division, a distributing division, and line circuits, each connected to two plugs, one plug at each division.
TELEPHONE SYSTEM. A. F. Swan, Bayonne, N. J., 572,840. Filed July 11, 1895.
Means in connection with any ordinary telephone instruments whereby several parties or instruments may be arranged on a line and any desired instrument cut in to the circuit while the others are at the same time cut out.

GREEN & BAUER, of Hartford, Conn., have equipped the Hartford Hospital with a set of Röntgen ray apparatus, which has already been used to good effect.

REPORTS OF COMPANIES.

COMMERCIAL CABLE AND POSTAL TELEGRAPH COMBINATION.

An arrangement has been made whereby the control of the Postal Telegraph Cable Company is placed in perpetuity with the Commercial Cable Company. The directors of both companies had meetings last week and acted on the arrangement. There is to be an absorption of all the Postal stock by the Commercial Company. The Commercial Company is to give in exchange a debenture, or collateral trust, bond upon which 4 per cent. will be guaranteed.

The capital of the Postal Company is $15,000,000. The Commercial Company's capital is $10,000,000. Neither company has any bonds.

A meeting of the stockholders of both companies has been called for December 22 to ratify the action of the directors. The new arrangement will cause no change further than to bind the two companies still closer together and perpetuate their present co-operative system.

The Commercial Cable Company directors have declared the regular dividend of 1¾ per cent., and an extra dividend of 1 per cent., payable January 1. The transfer books will close December 26 and reopen January 2.

SPANISH-AMERICAN LIGHT AND POWER COMPANY DEFAULTS ON ITS INTEREST.

The Spanish-American Light and Power Company, whose office is at 113 Wall street and plant in Havana and Matanzas, Cuba, is having a hard time on account of the war in Cuba. It is a New York State corporation, incorporated in 1883, with a capital stock of $4,000,000, and represents a consolidation of five gas and electric light companies in Cuba. It had a monopoly of the gas and electric lighting in Havana and Matanzas and before the war broke out its gross earnings, it is said, reached about $1,000,000 a year. Since then these have been considerably reduced, and the company is behind on its interest payment to bondholders, but has been paying up as fast as it could get the money. It was disclosed yesterday in the appointment of a receiver for Benjamin Giberga, who had been secretary of the company for a while, but who had resigned on Dec. 1, that the company had defaulted on the interest due on Nov. 1. The trouble, it is said, is due to the unsettled condition of affairs in Cuba, and particularly to the fact that the city of Havana won't pay what it owes the company for light. The amount is said to be $300,000.

BUSINESS OF THE NEW ORLEANS TRACTION COMPANY.

Some not unreasonable anxiety has been aroused of late in the minds of holders of the New Orleans Traction Company securities because of the earnings statements of the company for several months past. They have frequently shown a marked decrease from the results of the corresponding period in 1895. The statement for October shows that no marked improvement has yet begun, though the percentage of operating cost, while higher than in October last year, is decidedly better than that for October, 1894.

Inquiry on the subject of the road's present business shows that in addition to the bad effects due to the recent industrial depression, the company has also lost business by reason of the unsatisfactory service rendered by the Louisiana Electric Light Company, which has supplied the New Orleans Company with the power to operate its car lines.

This hindrance will in future be avoided entirely, since the company has just concluded an arrangement with the Electric Light Company by which the former will take entire possession of that portion of the electric light plant which was used to furnish power, and, having put in a division wall, will have entire charge of its operation.

It was recently stated that C. D. Wyman, who has been successful in charge of the traction system of Milwaukee, Wis., had been asked to take charge of the New Orleans system. It is now announced that he has signified his acceptance of the position, and will assume control next month.

WESTINGHOUSE DIVIDEND.

The Westinghouse Electric and Manufacturing Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable Jan. 1. At the meeting of the directors changes were made in the organization of the company. The offices of the general manager and assistant general manager were abolished and Lemuel Bannister was appointed first vice-president in charge of the commercial; B. H. Warren, sec-

ond vice-president in charge of the manufacturing, and P. F. Kobbe, third vice-president in charge of the financial department.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE BRODIE SINGLE POLE COMBINED SWITCH AND FUSE BOX FOR HIGH TENSION CIRCUITS.

WHEN double pole, out-door fuse boxes are employed on high-tension, alternating circuits the danger always exists of a short circuit being formed between the mains, with its consequent destructive action. It is for the purpose of obviating this constant menace that the Brodie Electric Company, of

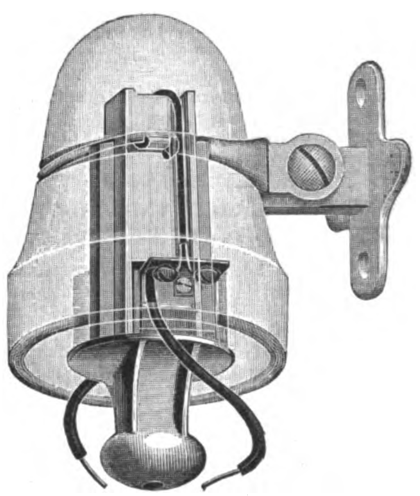


Fig. 1.—The Brodie Single Pole High Tension Combined Fuse and Switch.

Manchester, N. H., have designed a single pole combined switch and cut-out box for outside use on high-tension circuits. The illustration, Fig. 1, shows the device, which is made entirely of highly vitrified porcelain. In the engraving the

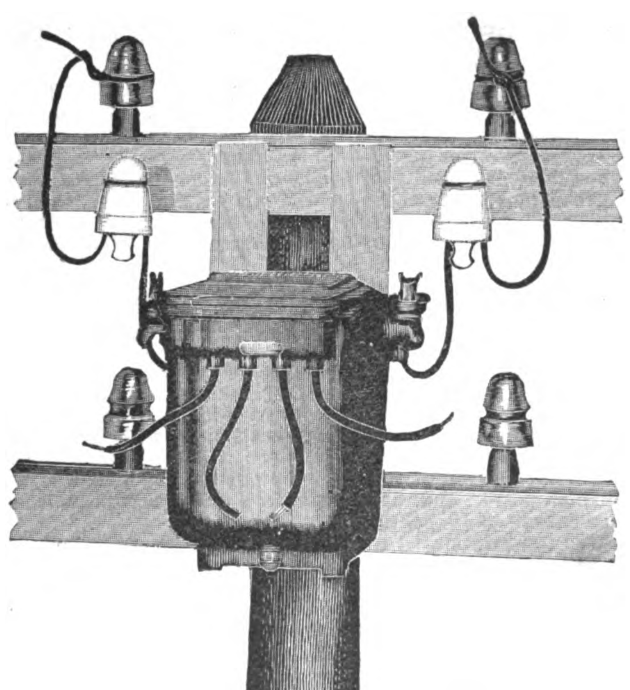


Fig. 2.—Brodie Combined Switch and Fuse, Mounted on Pole.

outer insulator is shown transparent, so as to clearly illustrate the construction of the plug.

The arrangement consists of an outside portion in the form of an ordinary insulator into a cavity in which a removable porcelain plug fits snugly, making the necessary connections. The fuse is carried in a groove in this plug, and as the plugs are interchangeable and very easily fused, the arrangement is a very convenient one. The circuit is opened when desired by the construction of the plug.

The construction is such that the arc formed upon the blowing of the fuse is instantly and certainly suppressed, and as the box is single-pole there is no possibility of a short circuit between the mains.

The petticoat of the insulator protects the electrical contacts from moisture, thus making it suitable for use with very high tension currents. The box is attached to its support by means of a malleable iron cleat, as shown, and is adapted for use on cross-arms, Fig. 2, or upon buildings, the cleat being screwed in place first and the box then attached. The contacts which hold the circuit wires are ample and easily accessible, and the arrangement is entirely weather proof.

The Brodie Electric Company are also manufacturers of the well-known "Brodie" automatic motor-switch, a perfect protection for electric motors against burn-outs and other accidents; and the popular line of "Brodie" insulators for tree and house use.

NEW GENERAL ELECTRIC MARINE ARC.

The General Electric Company's long-burning arc lamp has been adapted for ship use, both for the hold and on the deck. The "Marine" arc lamp is somewhat shorter than the standard long-burning arc lamp which has met with great success since its perfection, and is constructed to burn fifty hours without changing the carbons. The economy in carbons the use of this

Long Burning Arc Lamp for Marine Use.

lamp induces is considerable and this is added to in the saving effected in the labor of the trimmer. The outer globe of the Marine lamp is of clear glass and is cylindrical in shape instead of spherical. It is protected by a heavy wire guard against injury from outside. A large number of these lamps is already in use, both on the Atlantic and Pacific seaboards as well as on the Lakes.

THE EASTERN ELECTRIC COMPANY has been formed at New Haven, Conn., with a capital stock of $2,500.

NEW PORTABLE CABLE TESTING SET.

MESSRS. Elmer G. Willyoung & Co., of Philadelphia, have recently brought out a very compact and portable form of testing set for making measurements of the insulation resistance of underground and other high grade cables.

As shown by the accompanying engraving, the set is made up of galvanometer, telescope and scale, high resistance of 100,000 ohms, shunts, keys, and terminals for attaching the ends of cables being tested, the method of measurement being the usual one of direct deflections. The galvanometer is swung on gimbals and is adjustable about two axes passing through its center; the one perpendicular to its plane, the other lying in its plane. The adjustments are controlled by milled head screws.

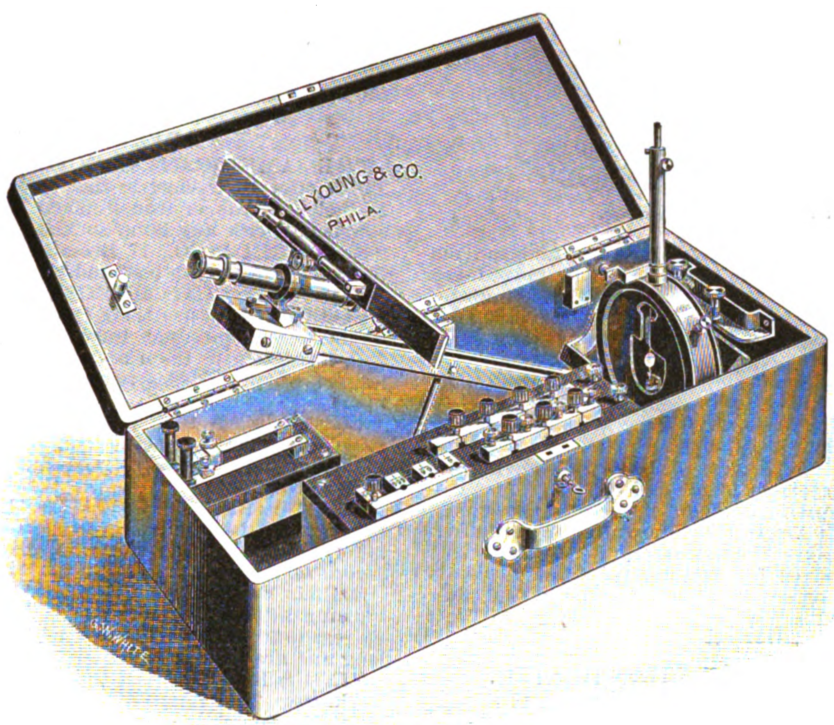
The telescope and scale are attached to the extremity of an arm which pivots around an axis lying in the plane of the galvanometer and passing through the center of the mirror; this arm rests flat in the bottom of the case when not in use, while the scale slips out of a kind of bayonet catch attached to the telescope casting and is held in a pair of holders seen at the side of the box. In consequence of the passing of this axis through the mirror center, the altitude and azimuth adjustments of the telescope relative to the supporting arm may thus be made once for all; the image of the scale must always reappear in the telescope by merely raising or lowering the supporting arm so as to secure the original angle with the galvanometer front. This supportng arm is held in position by a brass stem pivoted loosely upon it near the telescope and having an edge below which rests, ratchet-wise, upon a toothed rack. Hence when opening up the instrument for use it is merely necessary to adjust the galvanometer by means of the milled heads (regardless of the general level of the case which may rest upon a box, back of a wagon, on the ground), and then raise the supporting arm until the scale appears in the field, the arm remaining in any position to which it is raised. The entire time required to adjust the instrument in readiness to make measurement from its closed condition is about two minutes.

The shunts of this instrument are four in number, reducing the current passing through the galvanometer to 1-10, 1-100, 1-1000 and 10,000 of its original value. These shunts are not placed directly across the galvanometer resistance, as is usual, but across the galvanometer resistance plus an extra 100,000 ohm coil, the virtual resistance of the galvanometer circuit thus becoming over 100,000 ohms instead of only about 1,500 or 2,000 as would otherwise be the case. In this way the galvanometer resistance remains practically unchanged even though the moving coil should heat up a number of degrees under the sun's rays in field service—in case of the suspension breaking down and its replacement by a new one, there would be no sensible change in the galvanometer circuit.

This 100,000 ohm coil has another very important function to understand which attention must be directed to the well-known fact that the lead sheathing of a cable is itself a conductor for "return currents." These currents are constantly varying in value and location upon the cable, as the number of motors using power varies and changes in position. These variations of flow in the sheathing produce corresponding variable currents in the core of the cable. Hence when a steady current is sent from core through the insulation to ground, as it is in the direct deflection method of measurement, then variable currents superpose themselves upon the steady current and cause the motion of the galvanometer needle to be so erratic as to completely mask the steady deflection obtained. To overcome this difficulty the 100,000 ohm coil is wound with a maximum of self-induction, thus wiping out these variable currents, but offering no impedance to the steady current of measurement. This arrangement of inductive 100,000 ohm coil as also that of shunts outside of coil and galvanometer in series is the invention of Mr. W. D. Gharky, assistant superintendent lines and cables, Union Traction Company, Philadelphia.

All parts of the instrument possess the highest insulation, all metals and all conductors being mounted upon hard rubber, the galvanometer, coils, etc., being both moisture and dust proof.

With 100 volts this set is capable of measuring resistances up to something over 5,000 megohms, giving for this resistance about 10 scale divisions deflection.



WILLYOUNG PORTABLE CABLE TESTING SET.

As the galvanometer is of the d'Arsonval type, it is not affected by nearby electrical current or magnetic fields; neither is it affected appreciably by the ordinary mechanical shocks and jars of traffic. It is compact, measuring about 22¾x10x7¼ when closed, and weighs about the same as a dress suit case. The first of these instruments was made for the Union Traction Company of Philadelphia, about six months ago and has been in continuous daily use ever since and, we understand, is giving great satisfaction.

The set should be of great value to engineers and electricians in charge of underground construction, as it enables measurements to be made during progress of the work and any defects due to injury in "drawing in," etc., instantly located before the mischief has had time to develop and do perhaps irreparable damage.

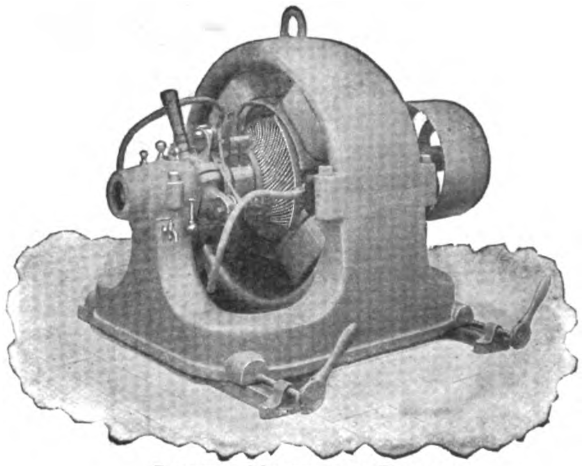
The apparatus is for sale by Mr. James G. Biddle, Drexel Building, Philadelphia, sole agent for Willyoung instruments.

MR. S. C. SCHENCK, for a number of years the New York expert for the C & C Electric Company, has resigned his position and has formed a connection as an associate with Mr. Thos. J. Fay. They are New York agents and exclusive exporters to Mexico, Central America, South America and the West Indies for the Crocker-Wheeler Electric Co.

THE NEW COLBURN FOUR-POLE GENERATORS.

THE Colburn Electric Manufacturing Co., of Fitchburg, Mass., have brought out a new series of multipolar generators designed to run at low speed, possessing a number of excellent features. The new generators, the general design of which is shown in the accompanying engraving, have laminated wrought iron cores, cast solid in the magnet frame, with compound wound magnet coils, which can be easily taken off. The design is such that the poles are short and influence the armature directly, thus giving the shortest magnetic circuit.

The armature is of the toothed type with the windings buried in slots and so constructed as to allow of the lowest possible resistance. The commutator is extra large, with tempered segments held in an improved and novel manner, and the machine is so well designed that the brushes can be moved over a large angle without causing sparking at the commutator. Another important feature consists in the fact that the commutators on these machines can be oiled freely without showing the least sparking.



COLBURN MULTIPOLAR DYNAMO.

The improved brush holders permit of giving the brushes any desired tension without stopping the machine, and they can be run continuously for months at a time without stopping, if required. This is made possible by the use of self-oiling boxes with double-ring oil feed, an oil sight showing the height of the oil in the reservoir at all times.

These machines are built for moderate and for slow speeds, belt driven, in sizes from 6¼ to 62½ kilowatts. The Colburn Company also manufacture the necessary accessories, such as automatic starting boxes for motors, potential rheostats, and also potential and current indicators for direct and alternating currents.

A NEW ELECTRIC CURLING IRON HEATER.

SINCE the universal introduction of electric lights in hotels, apartment houses and dwellings in our cities, to the entire exclusion of other illuminants, there has developed a demand for some method for heating irons for curling the hair. Alcohol lamps of innumerable forms have come rapidly into use, and have been a source of constant anxiety as well as no inconsiderable loss, due to fires resulting from accidents and careless use of these highly dangerous devices. Recognizing the demand for a safe and simple appliance, the American Electric Heating Corporation are introducing an improved electric curling iron heater so constructed that it cannot be in circuit unless the tongs are inserted in the heater. When they are removed, the circuit is automatically opened. The heater is made in nickel finish or polished brass mounted on polished marbleized base, complete with cord and plug for attaching to lamp socket. The current consumption is but 50 watts. For hotel use they are mounted on marble or other bases arranged to screw to the wall. Among other places, they have recently been installed as fixtures in the dressing rooms of the new Waldorf, and also the Majestic, in New York; also in seventy-five dressing rooms in the new addition to the Parker House, in Boston, besides which several additional large contracts have been secured. The illustration shows the general appearance of the device, which is a very attractive ornament, and provides an electrical Christmas present for the electrician's best girl.

NEW ELECTRIC CURLING IRON HEATER.

THE ELECTRIC APPLIANCE COMPANY.

The Electrical Appliance Company have just completed their fifth business year, and are congratulating themselves on the results. They began business five years ago, at their present location, occupying a part of the first floor of the building at 242 Madison street, Chicago. Their business has increased, demanding greater facilities from time to time, until now they occupy the entire building, and have a large basement, and the three large upper floors filled with valuable stock, and are one of the largest electrical supply houses in the United States.

Their supply line is very large and complete in every respect, and their line of specialties is perhaps the most desirable controlled by any one supply house in the country. Their facilities for transacting a large volume of business, to the satisfaction of the trade, and to their own profit is unsurpassed.

ADVERTISERS' HINTS.

THE AMERICAN ELECTRIC HEATING CORPORATION offer their electric foot-warmer at $7 (list). It is 9 by 10 inches, made of iron finished in black japan and may be connected with any lamp socket.

G. A. FREI & CO., 17 Bromfield street, Boston, claim their X-ray outfits are the best and cheapest.

THE IRON CLAD RHEOSTAT COMPANY, Westfield, N. J., notify and assure their customers that the apparatus they manufacture does not infringe any letters-patent owned or held adversely to them and further that they are prepared to protect all purchasers against any suit for alleged infringement.

THE CLIMAX GAS ENGINE COMPANY, 31 Fulton street, Brooklyn, are furnishing engines for high grade electrical work on guaranteed voltage fluctuation not to exceed one volt at full load.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., remind the public of their system of testing their engines before shipping and of sending each buyer a card giving the record of the test.

IDEAL ELECTRIC CORPORATION are advertising long-burning alternating arc lamps. They have no economy coil, no resistance, burn 100 hours with one trimming, are 30 inches long and are noiseless.

HINE & ROBERTSON COMPANY, 98 Cortlandt street, New York, say "the biggest kickers" are those who allow their plants to run down when by application of up-to-date appliances they can be made dividend payers.

ARMITAGE-HERSCHEL COMPANY, North Tonawanda, N. Y., build elevators to meet the most exacting conditions of speed, load and rise on direct alternating or phase circuits.

NEW YORK NOTES.

MR. MORTIMER NORDEN, of the firm of Miner & Co., New York, has applied for a receiver and dissolution of the partnership which previously existed between Edwin D. Miner, Edward F. Gavin and Mortimer Norden, composing the firm.

MR. CHAS. E. BROWN, who will be remembered as one of the pioneers in central station work, and was recently attached to the sales department of the C & C Electric Company, has resigned his position with that company with a view to taking up special work.

A CORRECTION.—In the advertisement of the Hine & Robertson Co., which appeared in The Electrical Engineer of Dec. 9, by an inadvertence the words "do not" were omitted from the fifth line of the first paragraph between the words "they" and "own." We have no doubt but that the average reader supplied the missing words in his own mind in reading the advertisement, but in order to avoid any confusion and uncertainty caused by their absence we call attention to the error and its correction.

Department News Items will be found in advertising pages.

THE

Electrical Engineer.

Vol. XXII. DECEMBER 23, 1896. No. 451.

Electric Lighting.

THE BRIDGE MILL POWER PLANT OF THE PAWTUCKET, R. I., ELECTRIC CO.

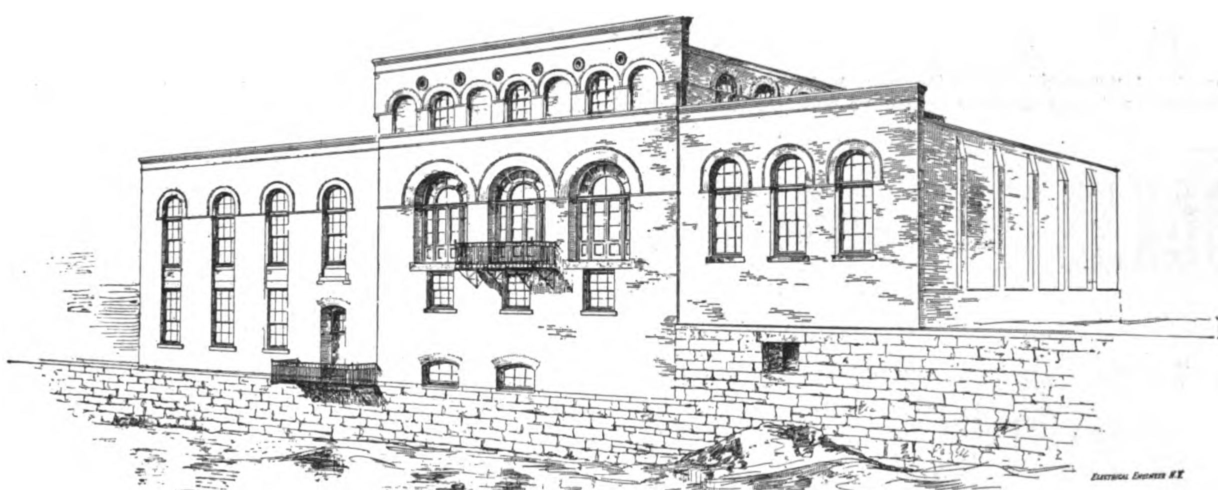
INTRODUCTORY.

THE Pawtucket Electric Company, of Pawtucket, R. I., incorporated May, 1896, is a consolidation of the Pawtucket Electric Lighting Company, owned by the Pawtucket Gas Company, and the Bridge Mill Power Company, owned by Messrs. D. L. and L. B. Goff. The first named plant was described in these columns when it was built some six years ago. It is sufficient to say now that it is a steam plant station fronting on the Blackstone river in Pawtucket about a mile below the Fall and conveniently situated for discharging coal direct to the boiler room. The buildings are all of brick with iron roof construction. The boiler room contains seven Bigelow horizontal tubular boilers; the engine room two Corliss engines of 650 horse-power each; and the dynamo room the usual arc and incandescent lighting apparatus. The station as a whole when it was built was an up-to-date one in every respect. Since the consolidation this station is now called the "Lower Station."

The "Upper Station," which is described below, is a water power station located right at the Falls in the very center of the city, with a 17-foot head of water and came into the possession of Messrs. D. L. and L. B. Goff in the following maner:

It was thirty-two years ago this fall, or in 1864, that the late Darius Goff and his son Darius L. Goff, began the manufacture of braids in the "Old Stone Mill" built on the East bank of the river in 1813. The business soon outgrew the narrow quarters and in 1872 the large brick Braid Mill was erected, and "Goff's Braid is the Best Made" became a household phrase. In 1874 the younger son, Lyman B. Goff, was admitted to the partnership. In 1883 the Old Stone Mill gave place to the larger and more modern brick structure now known as the Plush Mill. In 1884 the company was incorporated under the firm name of D. Goff & Sons. In 1885 Mr. Goff, Sr., then in his 76th year, and at an age when most men would have hesitated to assume new cares and responsibilities, made his first purchase in the property on the west side of the river by buying out the small interest of one of the numerous heirs. The records show that during that year he bought the interests of three heirs in the property. In 1887 he bought the interests of five heirs. In 1888 the interest of one heir, and in 1890 the interest of four heirs, having thus secured previous to his death in 1891 about one-half interest in the so-called "Pardon Jenks" estate, the "New Mill" and the "Grist Mill" estates.

In January, 1893, the remaining one-half interest, held by seven heirs, was bought by his sons and they thereby came into possession of the entire property, land and water power.



THE BRIDGE MILL POWER PLANT OF THE PAWTUCKET ELECTRIC CO.

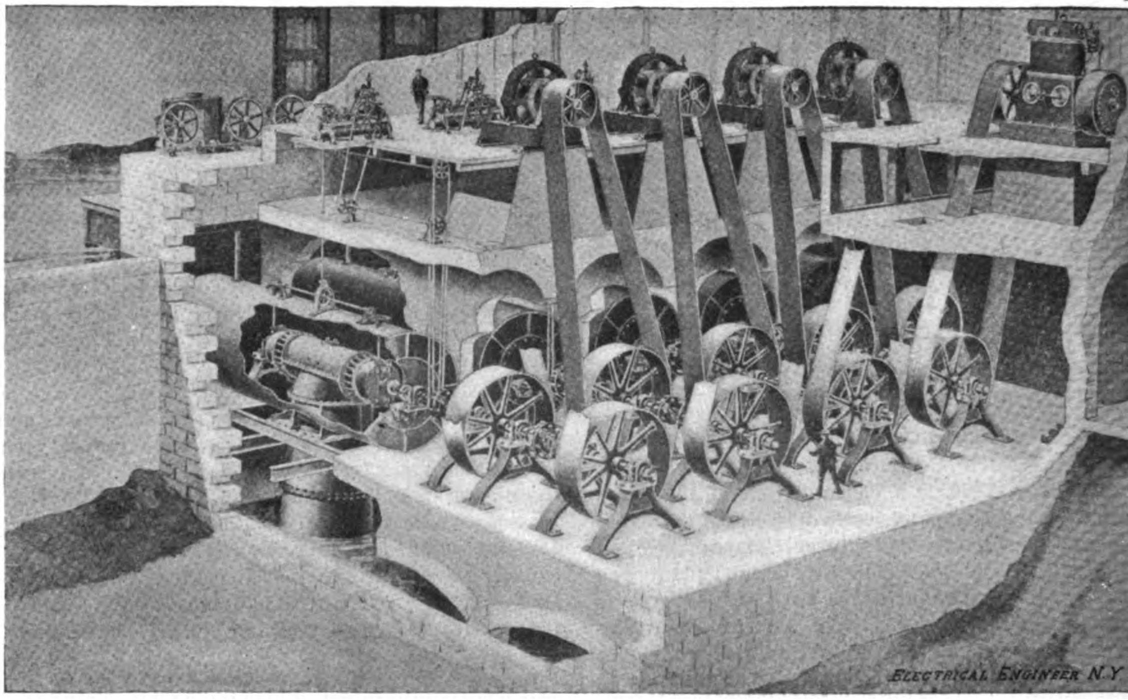
They immediately set to work to develop this water power, which for many years had been going to waste over the dam right in the very center of a thriving manufacturing city, to the wonder of every visiting stranger not acquainted with the peculiarity of ownership.

The original plan of development contemplated the opening of a new street 700 feet long through the property and the erecting of buildings on the same, the first floors to be for stores, the upper stories for light power for manufacturing purposes and larger buildings in the rear and on the river front for heavier manufacturing, all the power for the same to be supplied in the form of electric motors driven from the electrically equipped water power station.

THE HYDRAULIC AND MASONRY WORK.

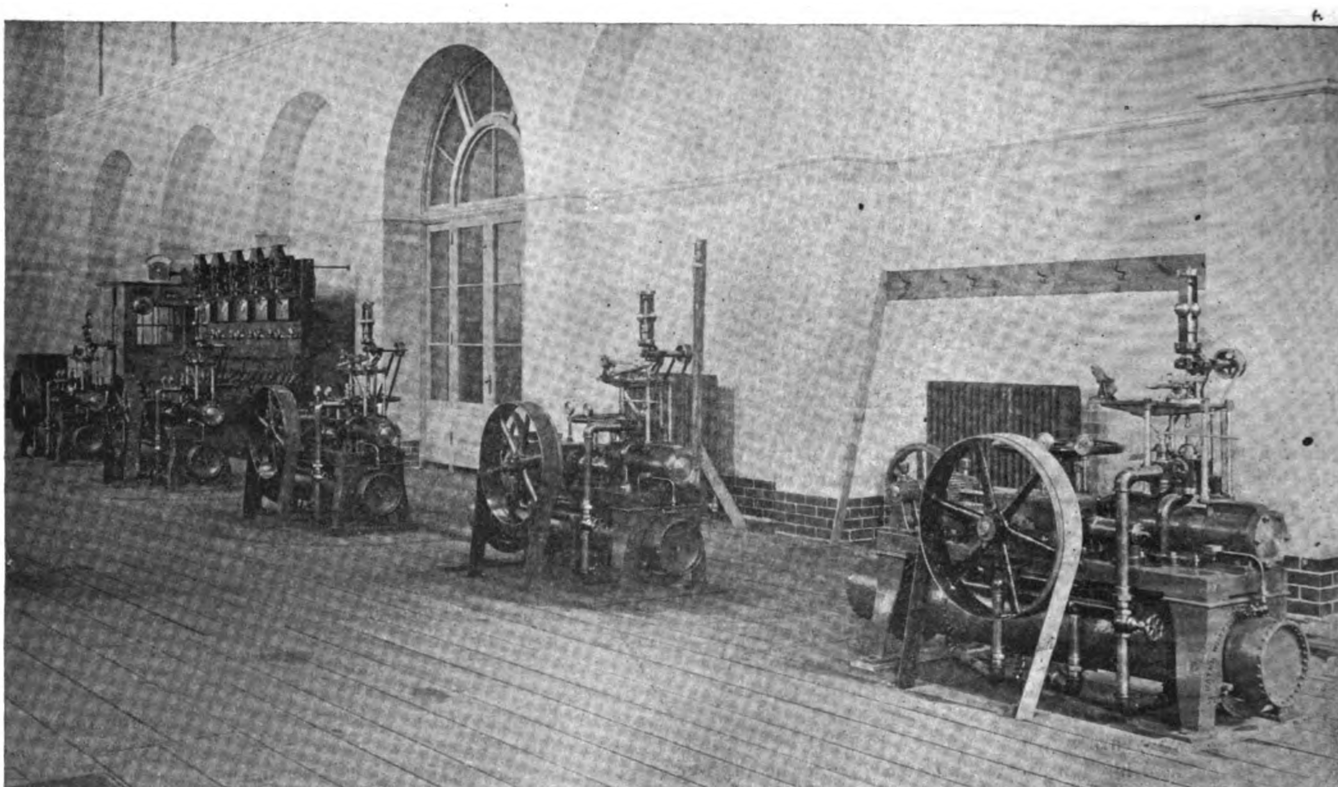
Messrs. Shedd & Sarle, of Providence, were selected as hydraulic engineers, with J. Herbert Shedd, C. E., as consulting engineer, and to them was entrusted the plan of masonry and brick construction, including brick dam, an underground

brick conduit 130 feet long and 17½ feet in diameter, forebay, penstocks, gate hoists, wheel pit, and wheel work. In July, 1894, a contract was made with Everson & Liddle, of Providence, to build a heavy granite retaining wall on the newly established harbor line and to do all the other masonry and brick work. All work exposed to water was laid in the best Portland cement and the construction is of an unusually substantial character. The superstructures, consisting of gate house, power house and boiler house, have since been completed and are all of brick with flat roofs of porous tile covered with asphalt and gravel, and were designed by Stone, Carpenter & Willson, architects, of Providence.



THE BRIDGE MILL POWER PLANT.—SECTIONAL PERSPECTIVE, SHOWING ARRANGEMENT OF TURBINES, ENGINES AND TRANSMISSION GEAR TO DYNAMOS.

(Copyright, 1896 by the Rodney-Hunt Machine Co.)



LOMBARD WATER WHEEL GOVERNORS IN BRIDGE MILL POWER PLANT, PAWTUCKET, R. I.

THE WATER WHEELS.

The water wheels and flumes for the Bridge Mill plant as also the power transmission equipment, were installed complete by the Rodney Hunt Machine Company, of Orange, Mass. There are five pairs of special 33" McCormick water wheels mounted on horizontal shafts in iron cases, and each flume is 10 feet in diameter and about 30 feet long. The aggregate power furnished by the wheels, with fall of 17 feet, is fully 1,300 horse-power.

The arrangement of the turbines and shafting are shown in the sectional perspective on page 638. The wheel shafts are 6 in. in diameter and are coupled direct to the extension shafts, with friction cut-off Worrall couplings, and another similar coupling is provided between the first extension shaft carrying a pulley 9 feet in diameter by 29 in. face and the second extension shaft carrying a similar pulley. One of these pulleys is belted direct with the dynamo on the floor above and the other is belted from the steam engine above, which is designed to run the machinery in dry or summer months when there is not sufficient water. This arrangement provides for driving dynamos with the water wheels or the steam engine, one independent of the other or using both together, disconnecting and connecting as desired without stopping the dynamo, and thus use the available water supply at all times to the best advantage.

The pulley shafts are suported by cast iron floor stands and pivot, self-aligning, self-oiling ring bearings, the elevation of the shaft center being 5 feet above the cement floor. The bottom of the stand covers a space on the floor laterally of 8 ft. 6 in. and is bolted to granite blocks embedded between steel beams set in the cement floor.

THE WATER WHEEL GOVERNORS.

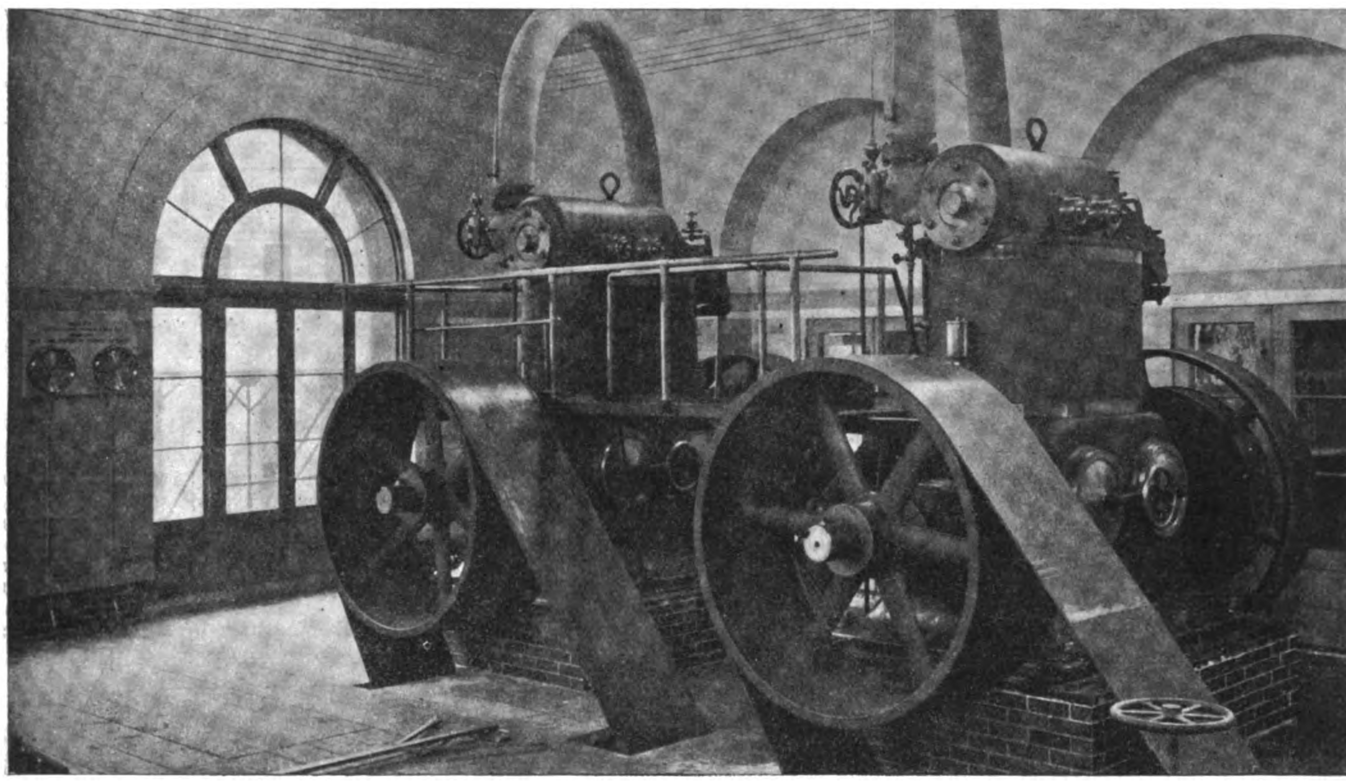
The five pair of water wheels above described are regulated by five standard Type C governors made by the Lombard Water Wheel Governor Company, Roxbury, Boston, Mass., and shown in perspective on page 638.

There are thus five units, each consisting of one pair of water wheels, one electrical generator and one governor. The system is perfectly flexible. The terminals of the electrical generators all go, through the switchboard, to one set of bus bars, and any one, or all, or any combination of the five units may be operated at will.

When more than one unit is in operation they have no positive connection through clutches, belting, or similar devices, but are electrically connected at the switchboard. Under these circumstances it was feared at first that there might be some difficulty in driving five pair of water wheels at near enough the same speed to avoid the ordinary difficulties of operating generators in parallel when driven by independent water wheels. It was found, however, that these fears were unfounded, and the gates of all the water wheels open and close exactly alike, so that they give the appearance of being in some way connected, though in fact all of the governors operate entirely independently.

As these governors start and stop the water wheels without manual effort on the part of the operator it is a simple matter to throw in or out of operation whichever, and as many, of the five units as the operator sees fit. Thus any water wheel may be started or stopped without touching a hand wheel, and in case of the entire load going off instantly, as frequently occurs through the opening of the circuit breakers, no attention is paid to the water wheels or governors, as they take care of themselves.

The load variations of this plant are such as are commonly found in electric railway stations and the governors easily hold the speed within three per cent. of normal, except in cases of circuit breakers opening, when variations of about five per cent., lasting about fifteen seconds, occur.



WESTINGHOUSE COMPOUND AUTOMATIC ENGINES IN BRIDGE MILL POWER CO.'S STATION, PAWTUCKET, R. I.

THE STEAM PLANT.

The steam plant connected with this station, which was installed by Messrs. Westinghouse, Church, Kerr & Company, is very complete so far as constructed, and although intended primarily as relay to water power, its use is sufficiently extensive and important to warrant the adoption of a number of advanced forms of construction and design. The illustrations on page 640 show the details of the engine and boiler arrangement.

The engines, of which there are two, are Westinghouse compound automatics, having cylinders 16" and 27" diameter and 16" stroke, and they run at a speed of 250 r. p. m. Their mechanical design and steam distribution make them especially adapted for the service and to produce the most economical results under the variable loads and conditions. Each engine delivers its power to one of the 150 kilowatt dynamos through jack shafts located in the wheel room below.

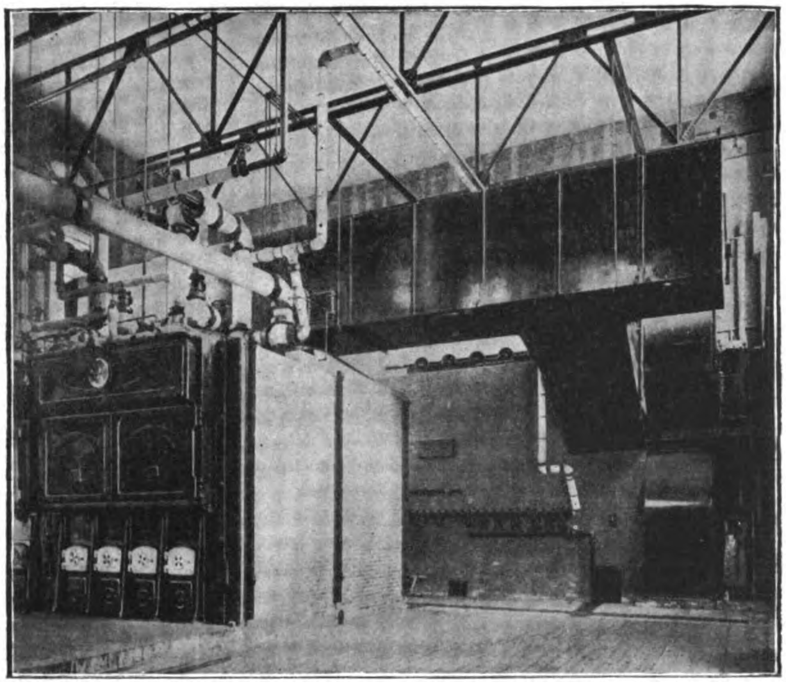
These jack shafts form an extension of the water wheel shafts, of which there are five located parallel to each other and to the engine shafts, and each is provided with two cut-off friction couplings operated from the engine room level.

The generators are belted from pulleys located between the two friction couplings and, as stated above, the arrangement

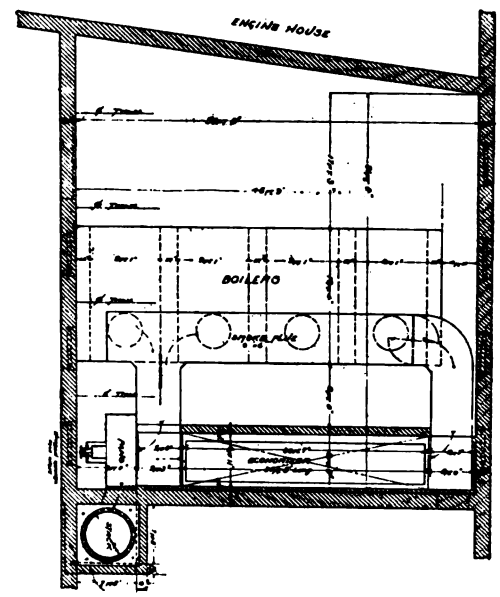
is such that they may be driven entirely by water, entirely by steam, or for that matter by both in conjunction should circumstances ever make it desirable to do so.

Each engine forms, therefore, with its companion wheel and generator, a complete unit, which can be independently adapted to the varying conditions of load, available water, etc., and always to the best advantage.

The engine receives steam through long bends of extra

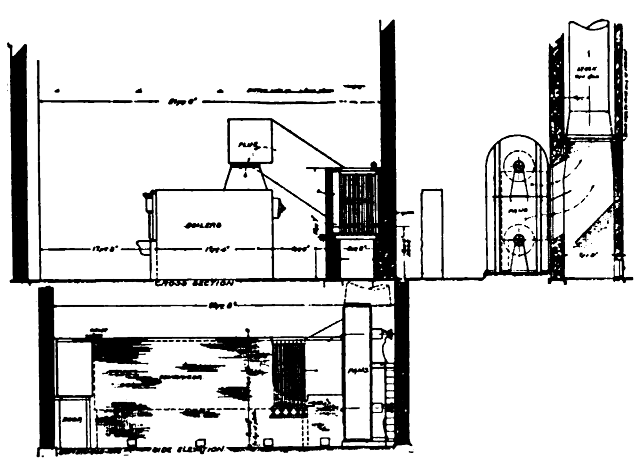


Bridge Mill Power Plant.—Boiler Room and Economizer.



Boiler and Economizer. Elevation.

heavy pipe rising from a header located in a high basement under engine room, and the exhaust is delivered to an exhaust system extending through the basement and into the boiler room where it is connected with a Deane independent condenser of suitable capacity to handle the exhaust of both engines. The general arrangement of steam and exhaust piping is shown on the accompanying engravings in plan and elevation, and is exceedingly well designed. A portion only of the ultimate plant has been installed, but the piping is constructed with special reference to the best arrange-



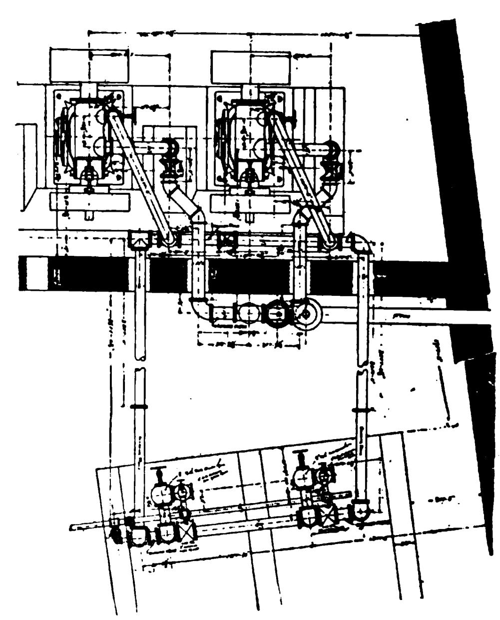
Bridge Mill Power Plant.—Boiler, Economizer and Fan. Elevation.

ment of the complete installation, and is planned for extension on the same general lines shown by the drawings. The plant is designed to run condensing, but may be run non-condensing at will. Provision has been made for changing to a non-condensing basis automatically in case of a loss of vacuum from any cause. All the fittings and valves in the live steam system are extra heavy and everything connected with the piping is of the very best. By the ingenious arrangement of the piping any portion may be cut out of service if desired for any reason without interfering with the general operation of the plant, and many of the advantages of dupli-

cate lines of piping are secured without their accompanying complication and cost.

Particular attention has been given to the matter of drainage for the live steam system, and this has been protected by a system of steam loops, the "horizontals" of which may be seen, in the view of the boiler room, hanging from the upper members of the roof trusses. These steam loops continuously gather up the water of condensation and entrainment that is present in the steam pipes and return it without moving mechanism to the boilers in a very satisfactory and economical manner. The feed piping is entirely of soft annealed brass tubing; all valves and fittings are also brass of heavy pattern and the connections between feed pump, heater, injector, economizer and boilers are cross-connected and by-passed.

The boilers are two in number and are of the Heine water



Bridge Mill Power Plant.—Plan of Engine Piping.

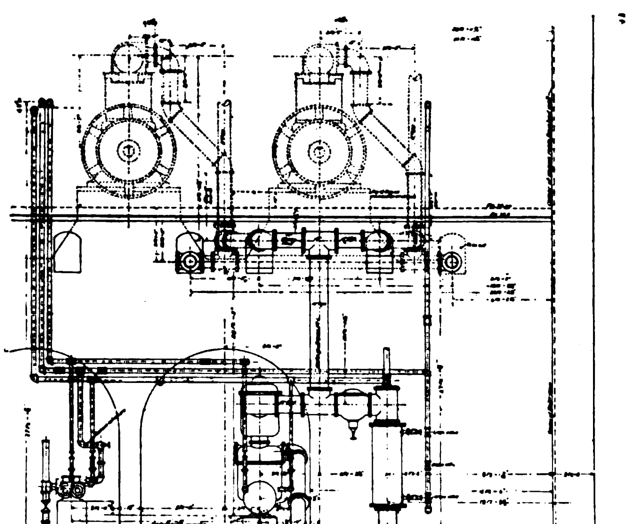
tube type. They are connected to a suplementary heating main not shown in the engravings, but which is intended for heating the braid mills of D. Goff & Son, located across the river. The products of combustion are carried by means of a suitable flue connection to an economizer and mechanical

draft plant, the principal features of which are shown in the illustrations.

This economizer and mechanical draft plant can also be seen clearly at the right and rear of the perspective view of their heat to the in-going feed water, which passes through the economizer where they give up a large portion of their heat to the in-going feed water, which passes through the economizer tubes. Beyond the economizer are placed two large slow speed fans arranged for exhausting the cooled gases from the economizer and providing draft for the fires. The economizer is of the improved circulating type designed by Westinghouse, Church, Kerr & Company. The circulating and blow-off connections are located outside of the economizer setting for ease in handling and cleaning and may be seen in the perspective view of the boiler room.

The fans are driven by direct connected engines, and are of the regular design of the contractors for this service. They meet the requirements imposed by the high temperatures of the gases handled most satisfactorily. They discharge into a short stack which extends only to a sufficient height to carry the products of combustion away from the building. A comprehensive system of relay has been arranged in connection with the economizers and fans so that either fan may be used to produce draft with or without the use of the economizer, thus absolutely insuring against stoppage of operation for repairs or otherwise.

The mechanical draft apparatus supplants the usual tall and expensive chimney and the economizer absorbs and saves a large amount of heat which would otherwise go to waste. Together they form a very complete and economical device for saving coal and making and controlling draft. When



BRIDGE MILL POWER PLANT.—STEAM PUMPS, CONDENSERS, PIPING. ELEVATION.

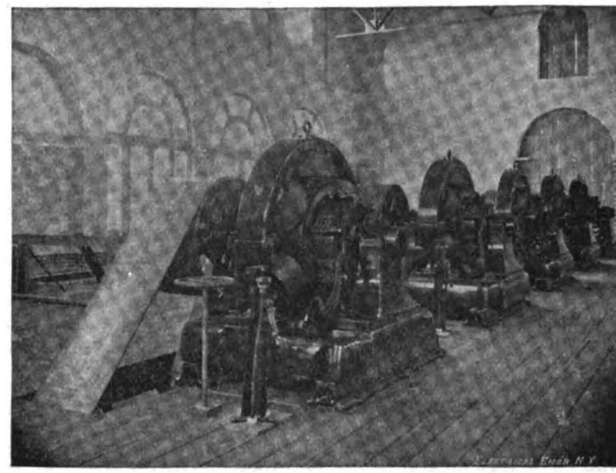
combined in this way the gases may be cooled to a temperature below that necessary for producing natural draft and a further gain in economy thereby made.

THE ELECTRIC EQUIPMENT.

The Bridge Mill Power Company have five of the latest type of General Electric 6-pole 150-kilowatt generators shown in prospective on this page, running at 400 revolutions. These generators are remarkably compact, and give an appearance of great strength and solidity. They have a cast steel magnet ring, and in general outline follow the lines of the General Electric standard 6-pole machines of the railway type. These machines have an overhung pulley, on which account the shaft is unusually large, being 5½ inches in diameter in the journal. The box next to the pulley is of extra length and size, by which means the strain due to the overhung pulley, is well distributed. The armature is of the ventilated "barrel" construction, which gives a firm, iron foundation under the entire length of the winding. The brush holders, of which there are six sets, are of the parallel spring type, with a positive path for the current, formed by a flexible copper cable attached to the holder at one end, and the other plugged into the top of the brush. Each generator is equipped with an equalizing switch attached to the separate stand near the machine.

The switchboard consists of one panel for each generator, equipped with a standard circuit breaker, ampere meter, and single pole quick break switches; one Weston illuminating dial voltmeter on a swinging arm answers for the entire switchboard. The dynamos are wound for a potential of 500 volts at no load, and 550 volts at full load, being over-compounded to that extent. The output of these machines is used for both stationary power and railway work.

One or more of these generators are used, according to demand, to supply power to the old station, operated by steam,



GENERATORS IN BRIDGE MILL POWER PLANT.

and located about three-quarters of a mile from the water power plant. In this old station is located all the alternating and arc machinery of the Pawtucket Electric Company.

CONCLUSION.

Mr. D. L. Goff, president of the consolidated company, has given almost his entire time for the past three years to every detail of this electric and water power plant. He has been ably seconded by his right hand man, Mr. George O. Capron, and to them is largely due the credit of producing what is considered to be the finest water power electric station in New England.

As the plant was nearing completion, the Bridge Mill Power Company obtained a contract to furnish power to the Interstate Railway, an electric line running between Pawtucket and Attleborough, and in addition were doing considerable motor work. They had also secured from the Legislature and from the City Council valuable franchises permitting the use of the streets for poles and wires, with the same privileges possessed by the Gas Company and under the same restrictions. They were likely also to be competitors for the city lighting at no distant day when the contract with the Gas Company expired.

It soon became evident to both parties, each strong in its own position, the one with its established business, and the other sure to become a troublesome rival from its more central location, its water power, and its modern and labor saving apparatus, that a consolidation was not only advisable, but almost inevitable. Hence the union which was consummated in May last. Six months business of the new company has proved the wisdom of the step in increased net earnings, and the outlook for a large and prosperous career is very bright. The officers of the company are: D. L. Goff, president; G. M. Thornton, vice-president; F. W. Easton, secretary; H. A. Pierce, treasurer and general manager.

EXPERIENCE WITH WELSBACH COMPETITION.

A leading central station manager in a large city writes us: "We have had more trouble from Welsbach burners this fall than ever before. It is fair to assume that the majority of our customers are using the Welsbach and only use incandescent light in the windows. We have to the present time been able to keep up our business regardless of this fact. I am not very much dissipirited as to the final result of the Welsbach, as I believe that the character of the light, the heat, etc., are going to drive it out eventually. Still, it is an evidence of the progress which is being made to utilize gas, while the electrical people are, so far as I know, sitting still almost in the spirit that everything has been accomplished. I have repeatedly urged that it is of the most vital importance to electric light people and the extension of their business that higher candle power be produced with the same energy as is now required by 16 candle-power lamps."

"ARE CENTRAL STATIONS DOOMED?"

BY "ENGINEER."

THIS is the heading which I find in the Dec. 2 issue of The Electrical Engineer. The best test of superficial reasoning or incorrect theory is experiment and I therefore venture to place before your readers the actual results of an existing Edison station and the profits of the same, leaving them to infer what they may from the facts. Names and localities are omitted, but the facts are correct.

The company was organized in 1887, with $1,000,000 capital, and the writer appointed engineer. The station began operations in March, 1889. It made money almost from the outset. Between 1887 and 1892 it had four presidents, all alike, directly or indirectly, drawing liberal salaries, and while differing in many respects, all frankly owning that they practically knew nothing of the business, which they must have felt divinely inspired to direct and get pay from.

In 1892 company matters had gotten into such a condition that the "business men" of the board preferred not to be prominently connected with its management. Its full paid stock had been sold at a forced sale at $45 for $100 and many private sales were made at $75. It was of no value as collateral. It had paid the parent company $335,000 stock for patents and to another company $75,000 for useless conduits and was paying other royalties and expenses all the time. It had its station completed to one-half its capacity. It had issued $300,000 in 6 per cent. debentures, and it could not manage to pay a dividend. The ship if not a wreck was certainly settling under the directors' noses. Some president must be found who would willingly or unwillingly sacrifice himself, so the board elected their engineer and manager to be president.

At the end of four years, in 1896, this same board of directors sold their works for $2,800,000 cash, and had not a dollar of indebtedness to pay, receiving a large bonus for material and accounts.

How was this brought about? Fortunately the engineer who felt so highly flattered (?) by his election to the presidency, was a skilled accountant, and it did not take him long after finding the trap he was in to realize that "something must be done," and above all things that the 6 per cent. bonds and their sinking fund of $25,000 per annum must be wiped out, so that the earnings of the company could go to the stockholders as dividends.

The station all this time was increasing its business and earning profits, but interest, sinking fund, and sinecure salaries were eating up what little was left after such increases of plant as were absolutely necessary were paid for.

The capital stock was increased to $2,000,000. The station machinery was completed to its full feeder capacity and the bonds were retired with a portion of the proceeds of the stock. This could not be done until a dividend was paid which was declared April 1, 1892.

A stockholder having 100 shares of the stock in January, 1892, had received by 1896, the following amounts:

	Profit.	Investment
	$4,000	$10,000
1892—Oct. 1, 7% cash	700	
20% stock at $1.40	2,800	
Dec. 31, 2% on 120 shares	240	
1894—March 31, 12% stock on 120 shares	1,440	
5% stock at $1.40	840	
1895—Dec. 31, 16% on 125 shares	2,000	
Besides receiving 25% stock dividend to cover profits invested in plant he was given the option of 75 shares at par worth at the time of sale, 140	3,000	$7,500
Dividends on purchased allotments	1,267	
	$16,287	$17,500

The stock of this company was exchanged for a 5 per cent. bond of equal value and $50 cash for each share. The bonds are now selling at 90 and therefore the stock is valued at 140 in estimate. The total profit was 93 per cent., or 23 per cent. per annum for the four years in the case of a stockholder, who retained what stock he had and took what he was offered for four years after 1892. The stock having risen from $75 to $140 per share, a stockholder who invested in 1887 would on a careful computation be found to have received upwards of 12 per cent. per annum, but it is sufficient for our purpose to show that the intrinsic merit of Edison's wonderful invention of the incandescent light is so great as to cause it to survive management that would be ruinous to any other business placed in the hands of speculators and unskilled men, as it is, and that with average good management it can be made to pay large profits.

There is little for central stations to fear—when they have fairly able and economical management (and the larger they are the cheaper they can sell light and power)—from small plants, such as the "block system;" but the impression that these central station and other electric stocks are unsafe or are unprofitable is gaining ground for another reason.

The same company that purchased the Edison station, to which reference has been made, for $2,000,000 in bonds and $1,000,000 in cash, have also purchased another electric company whose whole plant could to-day be duplicated for $1,000,000.

On their two plants worth	$3,000,000	
They have issued bonds		2,000,000
Preferred stock, 60 per cent. paid		3,000,000
Common stock		5,000,000
		$10,000,000
Water		$7,000,000

The preferred stock is not as yet fully paid in, but it will undoubtedly all be called. The common stock is given away. Speculation has been fast and furious, but some day the tide will turn and the water will be squeezed out of this stock as remorselessly as it has been in the case of the General Electric and the Westinghouse companies.

It hardly appears to the writer that "central stations are doomed," but the prevailing methods of stock manipulation are, and the sooner laws are enacted to prevent over-capitalization of these municipal lighting companies the sooner will the public be relieved from the impositions arising from the attempts of the companies to take from them four or five times a legitimate profit, and the stockholders will then feel secure that public opinion will not force legislation that will render their stock valueless, although they may be innocent holders, the victims of the adroit schemes of others.

"To insure to honest industry a just reward and to commercial enterprise a legitimate profit" (Pitt) should be the aim of our commercial laws, and all good citizens should frown on methods of business which work to the contrary, or Bryanism will grow, and like the rain, fall alike on the just and the unjust.

THE ELECTRIC ARC FOR LANTERN PROJECTION.—II.

BY E. P. HOPKINS.

WE will now describe the requirements necessary in the electric projection lamp different from those of the standard arc lamp for commercial purposes.

The lamp must operate in other positions than the vertical as the carbons have to be tilted away from the condensers to obtain the best light, and in practice it is generally necessary to tilt the lantern upwards to reach the center of the screen, so that sometimes it is impossible to use a gravity feed lamp; so for this and other reasons a spring-actuated movement is used which avoids all trouble in this direction, and if the parts become dirty, the spring will force the carbons together, irrespective of the position of the lamp.

When the arc lamp is in inexperienced hands it is very necessary that it should burn equally well with a small current as with a heavy one so that it cannot be burnt out. This is accomplished by using only a shunt regulating magnet of high resistance, and a small striking magnet of very heavy wire, which in the lamps now constructed will operate with 4 amperes or with as high as 20 amperes. Such lamps have often had 30 amperes passed through them, and in one case 60 amperes; the only effect being the burning of the insulation of the wire of the striking magnet on the negative carbon holder.

Perhaps oe of the most important points from the standpoint of the audience is a single adjustment in all directions and the alignment of the carbons, which is so arranged that the position of the carbons can be changed while the lamp is burning and the fingers not burnt, as the parts handled are well protected from the heat.

Fig. 6 shows the lamp complete with adjustable support and hood to keep in the light when attached to the lantern. Fig. 7 shows the lamp with the two side plates of the mechanism case removed, and also the hood. Fig. 8 shows the diagram of circuits and the detail of mechanism.

In Fig. 6 the know A is fixed to the main shaft of the movement which engages by pinions with two racks, both of which enter the top of the mechanism box. The upper carbon holder rack is guided by a sliding collar on the fixed guide bar shown in Fig. 7. From the sliding collar projects a lug through which the knob D screws; this screw presses against a lug projecting downwards from the carbon holder, which swings on the upper part of the sliding collar and is held against the end of screw D by a steel spring fixed to the top of the rack so that the carbon holder is always kept

in contact with the thumbscrew, D, and thus a most accurate lateral adjustment is produced.

Immediately above screw D in Fig. 6 are two screws; these support and at the same time insulate by mica the upper or positive carbon holder, the connection being made by a flexible conductor directly fastened to one of the binding posts of the lamp and the other end to a lug which forms part of the same casting as the carbon holder clamp. This casting

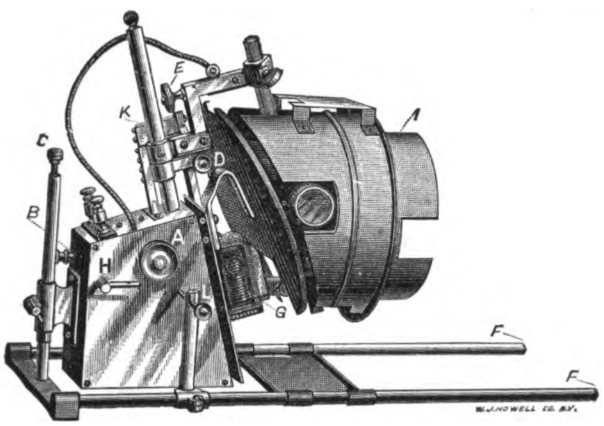


Fig. 6.

of the lug and clamps slide in a slot cut in the carbon holder arm, the former being moved back and forth and held in position by the adjusting screw E, Fig. 6. The knob of this screw is of black fiber, so that it can be handled when the lamp is burning; this is found to be very necessary when starting with new carbons and a perfectly equal illumination on the screen is required. After burning for about fifteen minutes, when the point of the upper carbon is properly shaped, it is advisable to advance the upper carbon so as to bring it more into line with the lower carbon until the carbons are about in the position as shown in Fig. 7.

The guide of the lower carbon rack K, Fig. 6, is a plate which slides on the front of the lamp, carrying at its lower extremity the striking magnet G. H is a lever to release by hand the movement to bring the carbons together if they are too far apart and the current is not turned on.

The lamp is supported by a clamp at the back of the movement box which firmly holds a tube stopped at the top by a

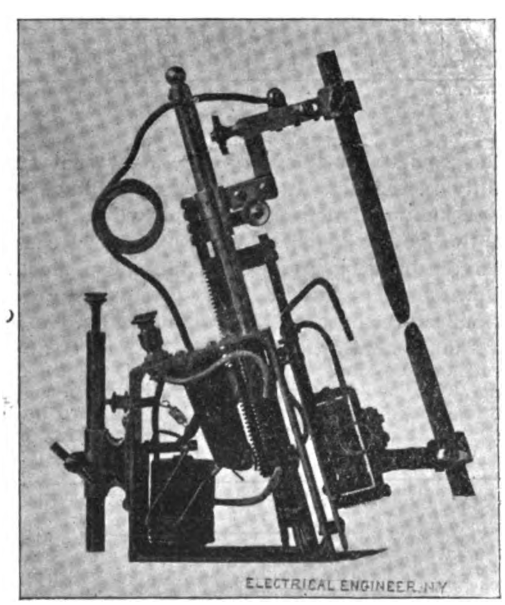


Fig. 7.—Colt Projection Arc Lamp.

plug through which screws the knob C. In passing into the tube it rests upon the top of the supporting post which fits loosely inside the tube, so that by turning the screw C in or out, the lamp will be raised or lowered, respectively, the weight of the lamp always keeping the screw C in close contact with the top of the supporting post so that there is no lost motion.

For quick adjustment the clamp on the back of the lamp, Fig. 8, is loosened and moved up or down the tube. L is the screw knob for the lateral adjustment, screwing through the upright post which is clamped to the guide rod F. The point of the thumb screw will push the lamp to one side, swinging on the back post and screw C. There is a spring pressing against the opposite side of the lamp which, being clamped to the other guide bar F, keeps the lamp in contact with the point of the thumb screw L. A small iron tray resting between the guide bars FF catches carbon dust and sparks that may fall.

The hood I is so constructed that there is ample space for ventilation and at the same time prevents the escape of light as much as possible. There is also a peep hole covered with very deep ruby glass, which appears black to everything else except the sun, through which the arc can be easily watched without hurting the eyes.

Fig. 7 shows the mechanism box with the side taken off and together with Fig. 8 illustrates clearly the entire working and circuits of the lamp. The spring movement is a train of three spindles with a verge escapement at R. On the main shaft 1 is the mainspring, one end fixed to the shaft and the other to the post of the movement frame. Spindle 1 moves the main gear by ratchet and pawl T, the pinions engaging with the two racks, V U. Being fixed to the shaft, when the latter is moved, the two racks, and therefore the carbon holders X Y, will move with them.

If the shaft is so turned that the carbon holders are separated, the mainspring, being fixed to this shaft, will be wound up, so that when new carbons are put in the lamp the spring will necessarily be wound up at the same time. The shaft 1 is moved by knob A, Fig. 6, so that the carbons can be separated while the lamp is burning.

In Fig. 8 the escapement tail Q engages with the catch P,

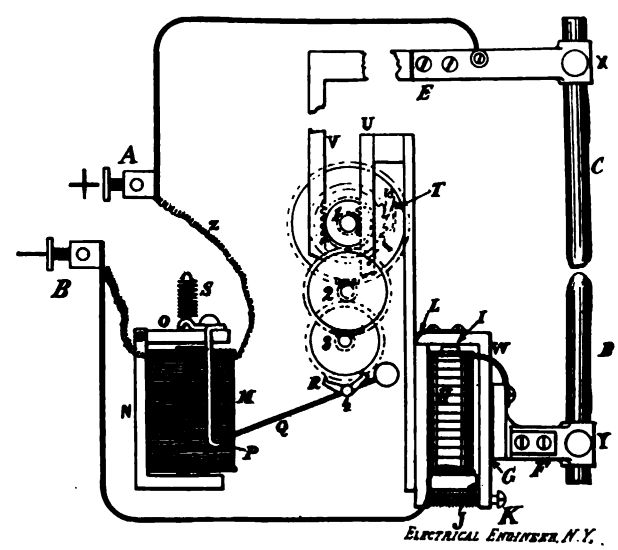


Fig. 8.

fixed to the armature O of regulating shunt magnet M, the retractile spring S being adjusted by the lock thumb screw B, Fig. 6, which is outside the body of the lamp. The armature O is pivoted on screw points passing through projections on the yoke N.

The operation of the lamp is as follows: After separating the carbon holders as far as possible by turning the knob A, Fig. 6, and inserting the carbons, connect up the positive main to binding post A and the negative to binding post B. Suppose the carbons are in the position shown in Figs. 7 and 8. No current will pass, as the carbons do not touch, and the carbon holders are insulated with mica at E and G; but the shunt magnet M will be energized, attracting armature O and catch P, thus releasing tail Q and escapement R, allowing the main spring to run down and to lower the upper carbon and raise the lower one until they come in contact; then the current flowing through the carbons and the series striking magnet H will draw down its armature at the two poles I and J and with it the holder Y, thus striking the arc. When the arc becomes too long the shunt magnet becomes stronger, releasing the movement and so shortening the arc until the magnet releases its armature.

On account of the escapement tail Q being long. there is very little friction for the armature O to overcome, so that the regulation is very close, sometimes regulating within 1 volt of change with 45 volts between the carbon points.

Once having adjusted the arc for a small current up to 6 amperes or less, almost any amount of current may be used, without affecting materially the mechanism or steadiness of the arc which will burn a little longer with more current, the mechanism automatically producing this change. Thirty amperes has been used with success; the only part that appeared to suffer was the insulation on the striking magnet H, but on account of its extremely low resistance it still operates when all the insulation is burnt off, there not being enough voltage between each layer to force the current through the oxydized surface of the copper wire.

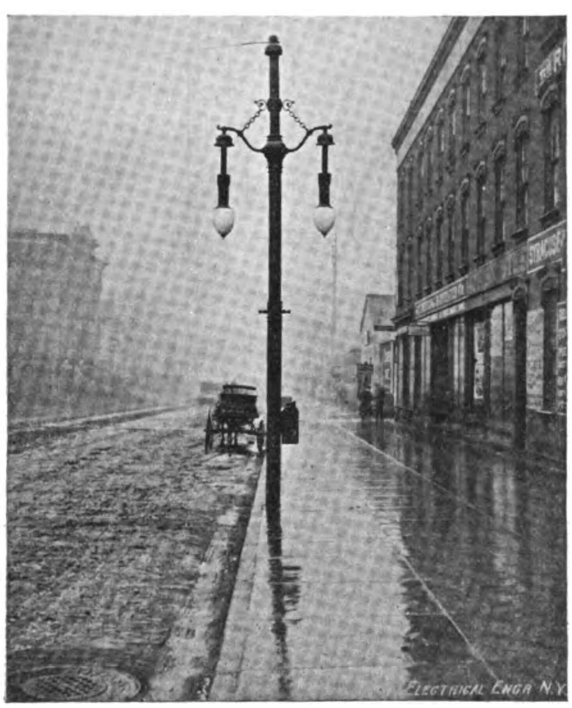
In order to avoid the heat of the arc a metal plate is fastened to the front of the mechanism box by four screws and deep washers which allows a good circulation of air to carry off the heat, besides the sheet iron hood shown in Fig. 6.

The lamp is very small and light, weighing only 6 lbs. The mechanism box 4⅝ inches long on the base, 3¼ inches long on top, 5⅛ inches high, width 2 inches; total height, 11 inches. This allows the lamp to burn about 2½ hours with 7-16 inch carbons and 12 amperes, with an upper carbon 8 inches long and lower carbon 4 inches long.

In Fig. 7 is shown an extra resistance of German silver wire which is connected in series with the shunt regulating magnet; this is to prevent the heating of the magnet M causing the latter to increase in resistance and so change the regulation by burning with a longer arc. By increasing the length of the carbon holders and by shunting part of the current from the striking magnet there is no limit to the amount of amperes that may be used with this lamp.

ARC LIGHTING IN THE CITY OF ROCHESTER N. Y.

IT may well be doubted whether any city in the Union is better lighted than Rochester, N. Y. The city has a population of 160,000, and has 4,100 arc lights, of which 2,200 are employed for street lighting purposes. This is a splendid showing, and is the more remarkable in contrast with that of



CANDELABRA ARC LIGHT POLE, ROCHESTER, N. Y.

Buffalo, which, although now calling itself the "Electric City," has by no means treated its local electric lighting enterprises with encouraging liberality. This disparity has attracted attention in both cities, and a representative of Dun's Commercial Agency said recently: "The city of Rochester is the best example in this respect in America. Between each business block they have six ornamental iron columns to which are suspended two huge milk glass arc light globes of very handsome pattern, in fact, the handsomest electric lamp-post in America. They have the appearance of candelabra, and belong to a progressive, wide-awake, metropolitan city. They would be thoroughly in keeping with Buffalo's matchless paved streets." Commenting further on the distribution of the lights, this observant critic said: "Buffalo has twenty-five arc lights within seven blocks on Main street, from Exchange to Genesee, while Rochester has in the same distance on her main street 174 arc lights of handsome design."

We illustrate herewith one of the Rochester posts, from a photograph kindly taken for us by Mr. George A. Redman, the general manager of the Rochester Gas and Electric Co. The poles are made of iron pipe, 8 inches at the bottom, 7 inches at the centre, and 6 inches in the upper part. About 18 inches of the top, including the cap, is of wood, to which the electric railway span wires are attached. The poles are owned by the street railway and the Gas and Electric Co., who now have about 210 in use. The Post-office authorities are employing them as supports for letter boxes, and experience no trouble whatever from the current. The poles stand 19 feet in height, and the rows of them up and down the streets, carrying milk glass globes, are a very pretty sight. The poles were built by the Walworth Mfg. Co., of Boston. The city officials who have had charge of the work for the city were Mr. Charles R. Barnes, city electrician, and Alderman A. H. Dewey, chairman of the Lamp and Electric Committee. Now that Buffalo has again to settle its lighting question, many of its citizens are hoping that their streets may be able to compare with those of the sister city.

POWER TRANSMISSION.

THE CHURCHWARD EQUALIZER SYSTEM OF DISTRIBUTION.

BY A. CHURCHWARD.

DURING the past few years many ingenious systems have been devised to get an economical system of power transmission, which shall have at least the copper economy of the three-wire system, without some of its drawbacks. The following is a description of such a system, which I have had in use in a central station in New York City for the past three years without a breakdown in the balance of the two cir-

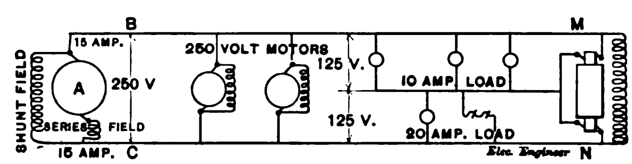


FIG. 1.

cuits. The capacity of this station is at present 1,200 k. w., and steadily increasing. In three years we have not lost a lamp from an unbalance of the light wires, and the character of the power supplied is very mixed, consisting of motors driving printing presses, machine shop, elevators, etc., arc and incandescent lamps.

Fig. 1 shows the system diagrammatically. A is a compound wound generator, 250 volts. B and C are the two mains leading to points of distribution. D is the central, or equalizing wire, used only in the district where lights are supplied. Suppose the two sides of the circuit to be balanced, then the current will flow from the generator through B to D

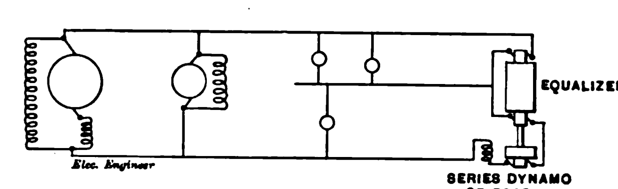


FIG. 3.

to C. But if the circuits are unbalanced, for instance 10 amperes between B and D, and 20 amperes between D and C, then 15 amperes at 250 volts will have to be supplied by the generator A. Ten amperes will flow from B to D through the lamps, the remaining 5 amperes will flow through the armature winding M of the equalizer, that end then be-

coming a motor; this will in turn cause the other winding N to become a dynamo and supply the necessary 5 amperes to complete the 20 amperes needed by the circuit between D and C.

In this system we have a single generator of 250 volts and a small machine which we call the equalizer, which is placed at the centre of distribution of the incandescent and arc

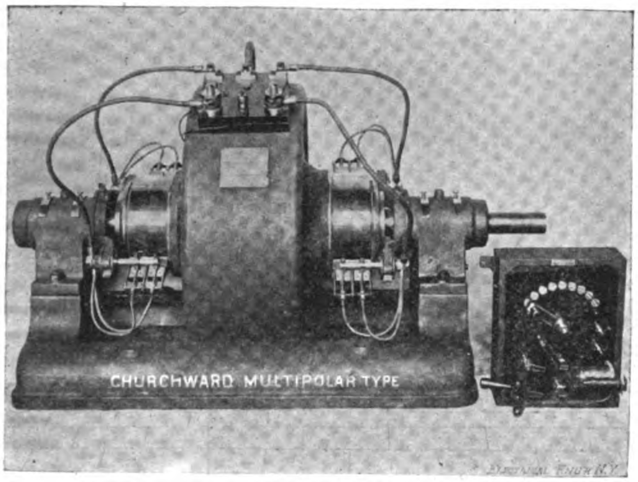


FIG. 2.—EXCELSIOR ELECTRIC CO.'S EQUALIZER.

lamps which supplies the third wire for lighting. The power is taken direct from the two outside wires, or, in other words, direct from the generator, while the equalizer is only used to preserve the balance in the lighting circuits. The standard proportion which we have adopted for the equalizer is 10 per cent. of the kilowatt capacity of the total lamps on the circuit.

In actual practice, however, an am-meter in the middle wire scarcely ever shows more than 3 per cent. unbalance, but

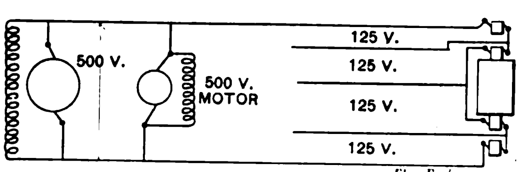


FIG. 4.

the extra capacity of the equalizer acts as a safeguard against short circuits, etc., or where focusing lamps, or arc lamps, are likely to be used on one side only. Thus, in a system using 100 k. w., viz., 50 k. w. in motors and 50 k. w. in lights, the size of the equalizer would only be 5 k. w., and cost very much less than a third or neutral wire from the generator to the point of distribution.

The equalizing machine shown in Fig. 2 has a single armature core having two independent windings connected to two commutators placed one on each end of the armature. One set of field magnets are employed, the coils of which are connected in shunt to the 250 volt mains. This gives only one field loss, one loss due to hysteresis and eddy currents, and only one set of bearings; and as the armature windings are

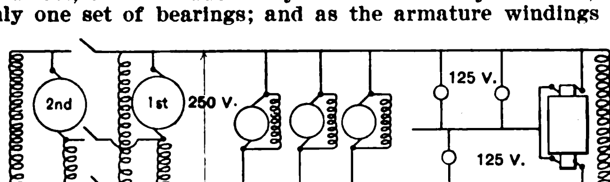


FIG. 5.

connected in opposition to each other where the machine is equalizing, there can be no armature reaction, no drop in speed, no sparking at brushes with change of load, so that the load limit of the machine is the carrying capacity of the armature wires. When the circuits are balanced the equalizers run free as a shunt motor across the 250 volt mains, ready to take care of the unbalance the moment it occurs.

Still another advantage of this system is that we can always compensate for the drop in the line at any point independently of others.

What might be called a "booster equalizer system" is shown in Fig. 3. When the heaviest loads are on the system and the sides balanced, all the equalizer does is to run free as a motor. Now by attaching a small series dynamo to the end of the shaft of the equalizer, and adjusting it to the load and drop, we can first boost the pressure and then equalize it; so that, given a district with various points of distribution, and various drops, we can run even the longest and heaviest loaded circuits at the same pressure as at the station.

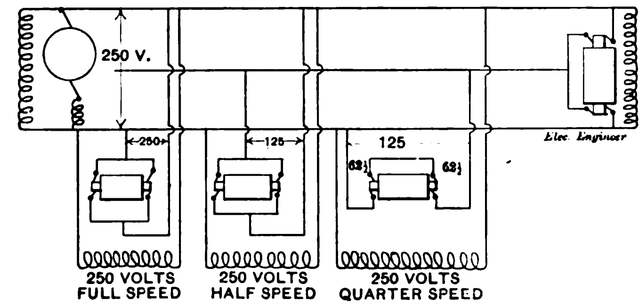


FIG. 6.

The equalizer system illustrated in Fig. 4 is not limited to 250 volts. Where a company has a motor trade much scattered, they can use, for instance, 500 volts, and run a long distance with economy, and put an equalizer in the centre of the lighting district and supply customers at 110 to 125 volts.

Having given a description of the system for power transmission from central stations, let us turn our attention to its special advantages in a factory. See Fig. 5.

To begin with, we change to electricity to overcome the losses due to belts and long lines of shafting. In the ordinary three-wire system we have two 50 k. w. machines (in a 100 k. w. installation) if in the day time the load averages 50 k. w., but at night when the lights are necessary a 100 k. w. So that in the day time the machines are not running at the most efficient point, averaging only one-half load.

By using the equalizer system, we will still have two 50 k. w. machines, but in the day time only one generator is needed, the load averaging 50 k. w., and it is, therefore, running at its highest efficiency in the day time; in case of breakdown the other 50 k. w. will always act as a reserve, and at night the two machines will run in multiple. See Figs. 5 and 6.

In many places where motors are used, variable speeds are required. If we use a resistance, we cut down the plant's

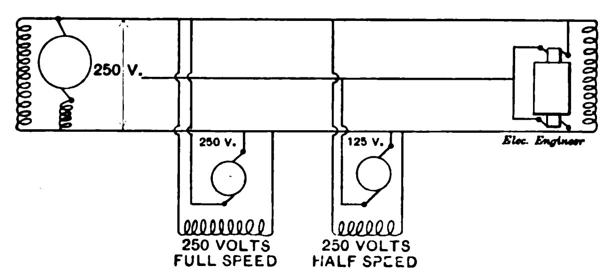


FIG. 7.

efficiency, and the speed will not be constant, but will vary with the load. Now, by having the equalizer larger than is necessary to balance the lights, the three wires can be used as a means of running the motors at a varying speed without the energy being consumed in resistance. By connecting the armature across 125 volts, and the fields across 250 volts, we can run the motor at a constant speed at one-half its normal, Figs. 6 and 7.

By making a special motor, with two commutators, or, in other words, using an equalizer, as a motor, we can reduce the speed to one-quarter, quickly, safely and economically, or any other speed desired can be obtained by varying the ratio between the two windings on the same armature core. And by having a resistance in the field circuit, the speed can be adjusted between any of two fixed points. When a heavy starting torque is required, as in cranes, elevators, etc., it will be self-evident that by these combinations, we can get the best results with the smallest waste of energy. A system possessing all these important advantages, certainly is worthy of consideration by engineers installing power plants.

THREE PHASE POWER TRANSMISSION AT ITASCA, WIS.

An interesting though small three-phase power transmission plant has been installed ot Itasca, Wis., just east of Superior, the division headquarters of the Chicago, St. Paul, Minneapolis and Omaha Railroad Co. At this point the shops roundhouses and storerooms of the railroad are located, and in their operation the company utilizes power for an average of 12 hours per day and steam the entire 24. About a mile and a quarter away from Itasca extensive docks have recently been built, and on them has been constructed a warehouse 1,500 feet long and 300 feet wide. Boats are loaded and unloaded on one side of the dock, tracks are laid on the entire length of the opposite side, and the cars load and unload their freight at any point in the warehouse.

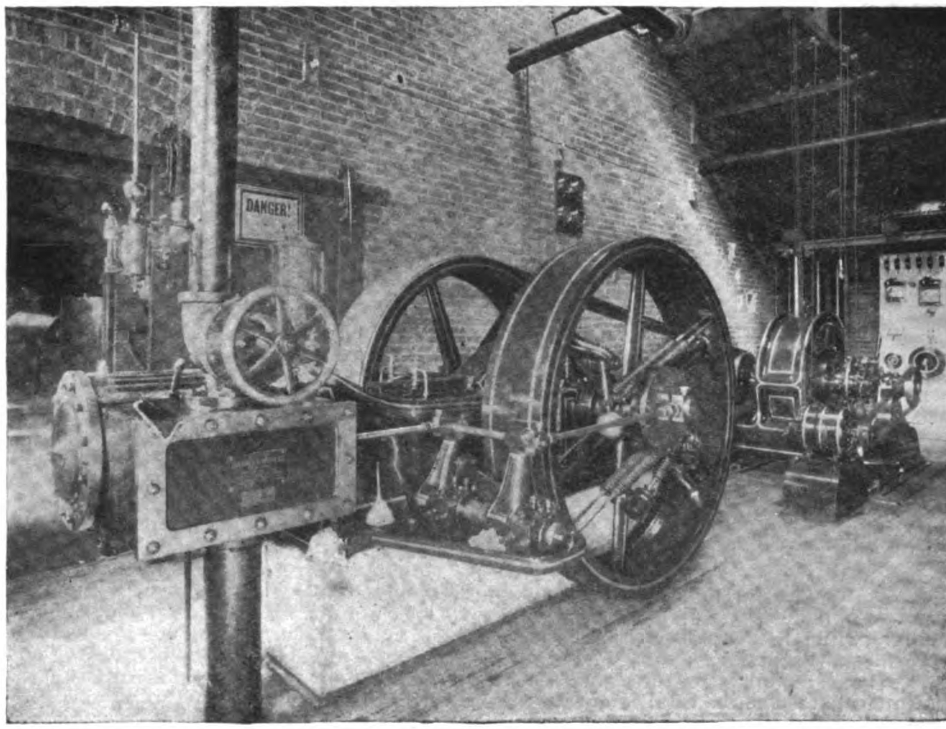


FIG. 1.—BALL & WOOD ENGINE AND GENERAL ELECTRIC 3-PHASE GENERATOR IN 3-PHASE PLANT AT ITASCA, WIS.

The protection of the warehouse from fire, containing as it does, many thousand dollars worth of property, was one of the first considerations after the construction of the buildings. and, naturally, the first idea was the purchase of a steam plant

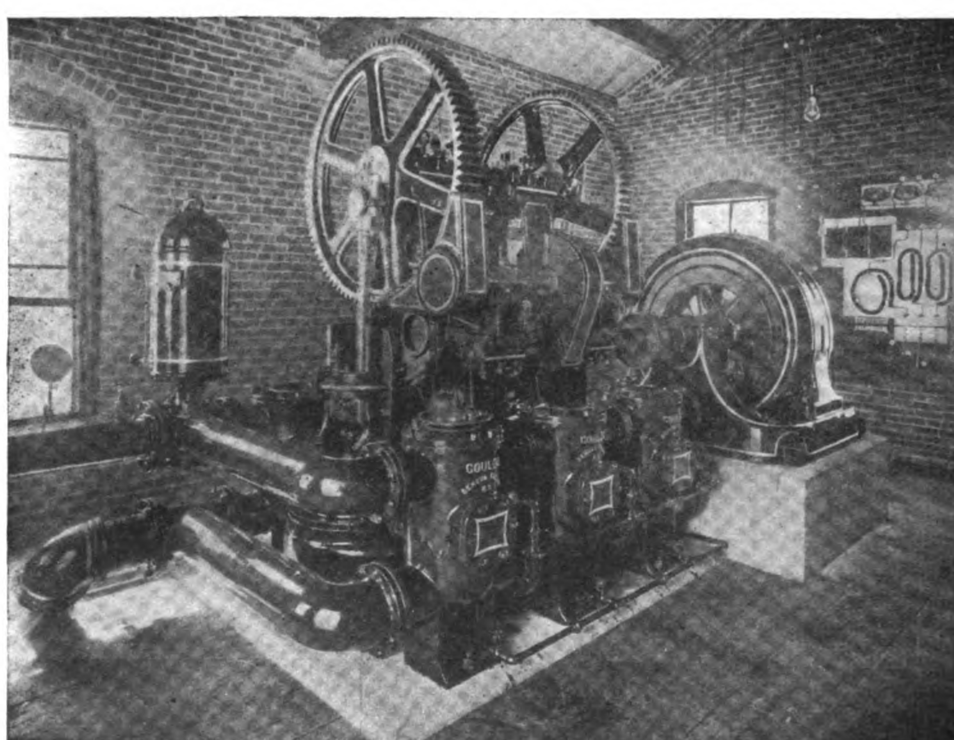


FIG 2.—PUMPING PLANT IN WAREHOUSE.

and pump. About this time the attention of the railway company was called to the numerous power transmission plants which the General Electric Company had installed, and they were not slow to take advantage of the merits of the three-phase system of transmission. Electricity carried the day, and at the present moment a 750-gallon pump is operating, and incandescent and arc lamps are scattered over the warehouse and dock, the shops, roundhouse and other buildings at Itasca, all operated by current from the power plant.

The current is generated by a General Electric 100 kilowatt three-phase generator, at a voltage of 2,000 volts, this pressure having been adopted in order to do away with the necessity of step-up transformers. The engine is driven at a speed of 900 revolutions per minute by a Ball & Wood engine of 110 horse power. At the dock the pumping plant is installed. This consists of a 75 General Electric 2,000-volt induction motor coupled to a Gould double-acting pump, having an output of 750 gallons per minute, operating at 80 pounds pressure and competent to throw four effective fire streams upon the docks and into the warehouse.

Mr. H. C. Hope, the superintendent of telegraphs and signals for the railroad company, states that the plant is one of the most perfect working light and power plants he has ever seen. All kinds of tests have been made with it, and the results have been satisfactory.

The dock warehouse is 1,500 feet long, and the inside is provided with five fire stations, fitted with electric fire alarm apparatus for transmitting signals between the docks and the engine house; also switches connecting the motor and the pump to the power wires. Hydrants and reels are suspended from the walls, each reel having 100 feet of hose, so that after the fire signal has been given from the engine house, one man can carry hose and water to the fire in from 10 to 30 seconds. A fire corps has been organized, and the men are drilled three times each week.

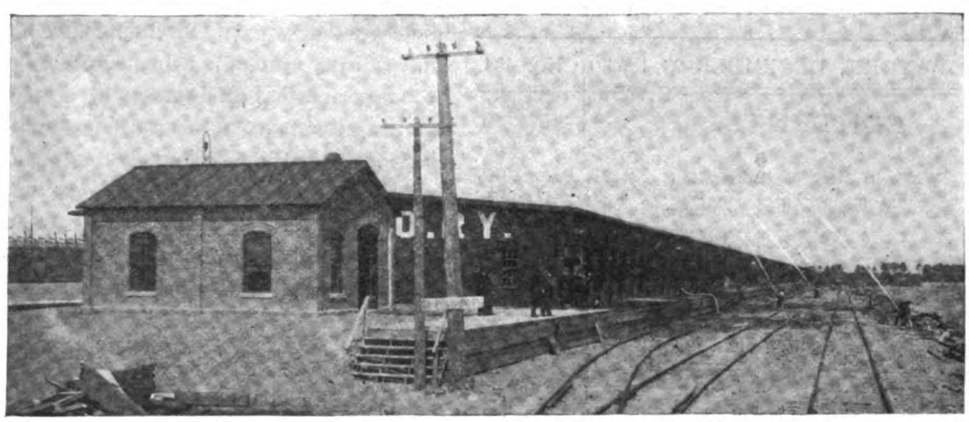


FIG. 3.—WAREHOUSE AND DOCK SHOWING STREAMS OF WATER.

The economy of this plant is markedly appreciated by the railway company. It has enabled them to save the expense of an engine and pumping plant at the dock, which means boilers, engines and all the various expensive accoutrements of such a plant and the maintenance of an engineer and an assistant, besides effecting considerable economy in the operating expenses. In addition to current furnished the pump, the generator also supplies electricity to twelve alternating current arc lamps, six on each side of the dock, supported on brackets from the sides of the building. Over 200 sixteen candle power lamps are required to light the warehouse, and in Itasca itself about 150 more sixteen candle power incandescent lamps are also installed.

This installation is a show plant in that district, and no railroad man who visits Itasca is allowed to depart before he has been shown the pumping plant. The insurance companies have also expressed considerable satisfaction at the adoption of electricity.

A CORRECTION.

An error crept into the article by Prof. Anthony on "A Method of Speed Control for Electric Motors," in our last issue. In the middle of the last paragraph but one, it says: "At the low speed the capacity would be unnecessarily small," etc. For "small" read "large."

POWER FROM PEAT.—There is a scheme on foot to furnish electric power to the City of Mexico from peat beds nine miles distant, owned by Boston interests.

ELECTRIC TRANSPORTATION.

ELECTRIC RAILWAY EXTENSION IN CONNECTICUT.

The New York, New Haven and Hartford Railroad is about to contract for a power house and two 850-kilowatt dynamos, to cost more than $100,000, for its new electrical plant at Berlin, Conn. With this equipment it proposes to meet competition by trolley parallels. The motive power will be for the Middletown and New Britain branches of the New Haven and the single track branch of the New England, between New Britain and Hartford.

A special dispatch from New Haven, Conn., of Dec. 15, says: As the session of the State Legislature draws near, it becomes evident that the number of new trolley schemes will exceed even the great record of the session of 1893, and that the conflict of the New Haven Company with the electric companies will be a very severe one. There will be more points of antagonism between the steam and trolley interests than ever heretofore, and the steam companies will have to fight, not only existing and operating trolley companies, but not a few new ones on paper seeking charters merely for the purpose of selling them.

Among proposed companies which have made or will soon make petition to the Legislature is one proposing to build from Milford to Stratford, which would connect the New Haven trolley system with that of the Bridgeport Traction Company, and also proposes an extension northward to Derby, Ansonia, and Shelton. Another proposes a line westward from New Haven through Woodbridge to Seymour; and yet another plan is for the extension of the Bristol and Plainville line through Terryville and Plymouth to Thomaston, where it would tap the Naugatuck valley. All these are either direct parallels of steam lines, or short "cut-offs" between steam roads more serious in competition than parallels. Already the length of these proposed parallels or "cut-offs" affecting steam roads amounts to about 140 miles, or about one-third more than the whole mileage of existing trolley parallels, which is largely made up of old horse railroads electrified. The figures are an index of the dimensions of the approaching steam-trolley contest, with the opening of the Legislative session still three weeks hence.

ELECTRIC RAILWAY WORK IN CHICAGO.

A mortgage for $3,000,000, covering all of the real and personal property, right, and franchises now owned by the Suburban Railroad Company, to the Chicago Title and Trust Company has been filed for record. It is given to secure an issue of twenty-year 5 per cent. gold interest-bearing bonds, to be dated March 2, 1896, and mature in 1916. An immediate issue of $1,250,000 of the bonds will be made, with which the company will build a double-track road from Harrison and West Forty-eighth streets west through Cicero and Harlem to Desplaines avenue. It will also build a double-track road in Twenty-second street in Cicero, and another in Robinson avenue. It is also to defray the expenses of equipping with electricity the line of railroad in Cicero. The remaining $1,750,000 will be used to purchase additional equipment and right of way.

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CONTENTS.

ELECTRIC RAILWAY WORK IN NEW YORK.

In a letter addressed to the daily press last week, General Herman L. Haupt, who is prominently identified with one of the companies whose compressed air motors have been on trial on the tracks of the 125th street line in New York, presents the advantages of this type of motor for street railway traffic, as compared with electric traction, whether overhead trolley, or conduit. Of course he recites all the old, threadbare "drawbacks" and "dangers" that were the former stock in trade of cable railway promoters and the old fogies of the bad old horse car days, but which railway men from Maine to California now smile at. Unfortunately for General Haupt, his project comes too late as the management of the Metropolitan Railway Company, of New York, has already decided, after mature deliberation, to adopt electric traction and with it the conduit system. As already announced, it is intended to equip shortly the Fourth, Sixth and Eighth avenues electrically, and we understand that the company is now negotiating for 600 electric cars to operate these lines. As regards the underground system to be adopted, we learn that the Love conduit railway system is being favorably considered, and indeed it is reported that an offer has been made to the Love Electric Railway Company, to install its system on forty miles of railway, provided the latter company agrees to change over, gratis, the Lexington avenue cable road to the new system. But whichever system is adopted its success is assured. Of course "troubles" are to be expected before an extensive system of this nature is in thorough working order, but in the meantime we may expect to see the most made of these installation defects by the opponents of the electric system.

But though we disagree entirely with the advocates of the compressed air system we are bound to admire their pluck. Not content with the surface railways they are actually contemplating to tackle the elevated railway system of New York, on which an experimental compressed air locomotive is soon to be tested. This is truly jumping from the frying pan into the fire. The conditions of working on these roads is so exacting that success seems almost hopeless. Not that a locomotive with sufficient power cannot be designed, for that is a comparatively easy matter; but actual operation, we are convinced, will require so large a quantity of reserve power to be carried as to make the weights to be hauled impracticable. Thus it is proposed to carry in reserve about one-quarter or one-third the quantity of air beyond that necessary for a round trip. Yet in cases of accident locomotives on the elevated roads have been compelled to travel distances of nearly twice the length of the round trip, and in addition haul in a disabled

train. Then, again, in wet weather with slippery tracks a slip of 25 per cent. and more has been noted covering a round trip. This means nothing in the case of the steam or electric locomotive, beyond a loss of so much energy pure and simple; but in the case of the compressed air locomotive it might mean a complete exhaustion of the source of power before the trip is finished. One can better imagine than describe the condition of affairs on the elevated roads with two or three air locomotives unable to move for lack of power. We wish our compressed air friends no ill, but would advise them for their own peace of mind and safety of pocket to let the elevated railway severely alone; and, if they must engage in railway work, to confine themselves to the surface of the ground.

Apropos of the elevated roads the experimental storage battery locomotive now running on the Thirty-fourth street branch of the Third avenue line has shown up remarkably well. We are not at liberty to give the details of the results, but we have no hesitation in saying that they are surprising and we believe that they have made a most favorable impression on the elevated railway management. We confess the results are better than we expected.

ALL WITHIN ONE REIGN.

A CURIOUS reminder of the shortness of the period within which the great electrical discoveries and inventions have taken place is given in the clever little group etching just issued by Mr. Frank Paton, a clever and versatile English artist, whose work reminds one sometimes of Frith, sometimes of Landseer, sometimes of Cruikshank, but has always its own characteristics. Some of his work is very popular, in England, and we imagine that his "Recollections of a Record Reign" will enjoy a wide circulation. Copies of the etching have already found their way to this country. The center of the etching is a picture of an old mail coach bowling through Temple Bar in 1837, and then around are grouped a number of little sketches or portraits, one for each year down to 1896. For the year 1837, we find a sketch of the telegraph wires and poles; for 1866, a section of the Atlantic cable; for 1877, a kobold with the electric light chasing away a man with a gas meter; for 1879 the telephone set. Had Mr. Paton been living here he would certainly have rounded out his electrical notations with the modern trolley, but the average Englishman hardly yet knows that such a thing exists; so that much may be forgiven to an artist who is so well informed as to do justice in this graphic way to a number of other branches of electricity. It is indeed striking that all should have come within the period of a single reign, long though that reign was; and that the United States should have had so much to do with the invention and perfection of each of these arts.

A MODERN HYDRAULIC AND STEAM ELECTRIC PLANT.

EVEN in these days examples of good central station engineering are not as plentiful as one would like to see them, and hence good work in this department is all the more worthy of notice and study. One of the best recent examples is the Bridge Mill Power Company's station at Pawtucket, R. I., which possesses additional interest in that it represents a type of station which will become more common as time passes. There are many places where a large proportion of a water power is available during most of the year, and we commend to owners of such powers a study of the station described in this issue. Both the hydraulic and the auxiliary steam plant have been laid out with more than usual care, and the result has been an extremely economical rate of working. Among the several noteworthy features of this installation, the system of water wheel governing which has been adopted is specially worthy of mention. It is not so long since water wheel regulation for dynamo driving was still considered to be one of the things which might some day be accomplished. Indeed we recall instances where "regulation" is obtained by throwing resistances into the circuit equivalent to the load taken off the outside lines. The results obtained at Pawtucket will therefore be of special value as demonstrating an accomplished fact, in a very important branch of engineering.

ELECTRIC FOOT WARMERS.

THE idea of putting an incandescent lamp into a bed to serve as a foot warmer is ingenious, if not entirely new, but it requires care in its employment. Mr. Van Cott, of Unadilla, N. Y., went out skating, returned home with cold feet, and took a lamp to bed with him after warming his hands with it. The flexible cord was long enough to permit the use of the lamp in this way; but as the glass bulb had no wire guard, it got crushed by the feet of Mr. Van Cott while he slept. This did not awaken the tired skater, but as the current still remained on, the bed clothes soon caught fire, and Mr. Van Cott found his feet warmer than was altogether comfortable. He jumped out, friends came to his assistance, the fire was extinguished in the room, the bedding was thrown through the window to consume itself in the yard, and Mr. Van Cott now limps around on wounded feet, but with a larger knowledge of the principles of electricity. We do not wish to discourage such amateur trials, but would suggest that persons in need of electric foot warmers should not take unprotected lamps to bed with them, but should buy proper apparatus now on the market.

CENTRAL STATION ECONOMIES.

FEW articles have appeared in these pages of interest greater than that attaching to the narrative furnished to them for the current issue, dealing with the history of a large central station and with features of its management. This piquant, brilliant sketch has been called forth by the recent suggestive article of Mr. Max Osterberg, on the fate of central stations, and is another evidence of the fact that a lively discussion was set going by that gentleman when he took up the argument for isolated plants. The author of the article which we print this week is an engineer of the first eminence and he has told his story with a frankness which is simply starting. He certainly places it beyond cavil that central stations in good localities, if properly carried on, are enterprises of an excellent kind, and that there are sure to be more of them before there are fewer. We do not often see articles so plain and outspoken as that by "Engineer," and it is safe to predict that it will be read with very close attention.

FARE REDUCTION IN CHICAGO.

THERE appears to be no little stir on the subject of street car fares in Chicago, and a recent step has been the passing of an ordinance by the city authorities fixing a 4 cent fare. This, of course, the companies are fighting. Mr. Yerkes estimates the loss to the West Chicago road at $2,000,000 gross per annum. We doubt very much whether the roads can live under such a reduction, but we have no doubt on the point that by such a reduction the companies will have to cut down expenditures now borne with the object of increasing public facilities for travel.

TELEPHONY AND TELEGRAPHY.

THE DE VEAU SUBMARINE DIVER'S TELEPHONE HELMET.

A VERY ingenious and interesting form of telephone system for the use of divers operating in either shallow or deep water, has been invented and worked out by De Veau & Co., of 32 and 34 Frankfort street, New York. It is very clearly illustrated in the accompanying cuts, Figs. 1 and 2.

The main idea in such work must be, of course, to leave the diver as unhampered as possible when using such auxiliary

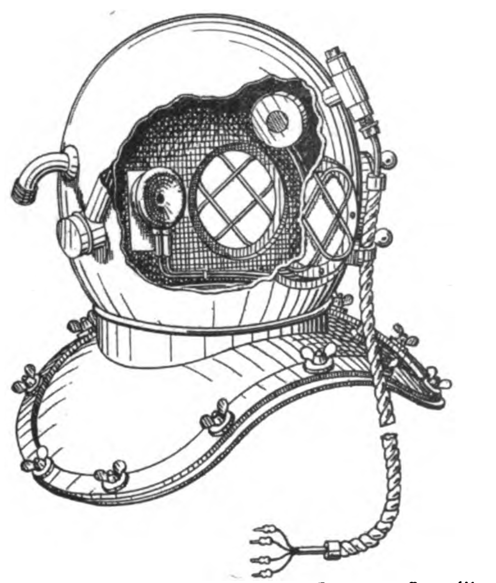


FIG. 1.—THE DE VEAU DIVER'S TELEPHONE HELMET.

devices. In other words, the presence of the telephone should change no conditions whatever, so far as making any demand on the diver's vigilance, activity or dexterity is concerned. In the engraving, Fig. 1, part of the helmet is shown cut away, in order that the arrangement of the apparatus within it may be seen and understood. The transmitter is just above the diver's head, and is No. 107 De Veau form. The receiver is closely adjacent to the left car, and is of the ordinary watch case type, No. 8½, as made by the firm. Both positions are

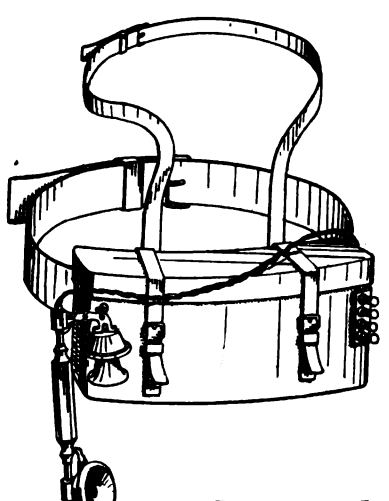


FIG. 2.—THE DE VEAU DIVER'S DECK TELEPHONE OUTFIT.

exactly suited to get the best effect from a conversation with the interlocutor at the surface. The circuit is formed by two wires, the lines running through the center of the manila rope, shown attached to the helmet. There is, as will be noted, a little junction box outside the helmet, and a little collar to relieve the strain that might come on the cable. Special pains were taken with this manila cable, which is wound with the spirals of the strands lying closely like those of a spring, and unusual protection is thus given to the insulated wires inside it.

Fig. 2 shows the box and set carried by the man on deck, strapped to his body, so as to relieve him also of extra demands on his hands or attention. In the box is the induction coil for the system, and all the accessories, including four cells of Mesco battery. The little switch on the deck set cuts in the battery for both. When the diver is not talking to the man on deck, and wants to attract attenion, all he has to do is to jerk his life line. The four binding posts on the box serve for the batteries and the two talking wires. It will thus be seen that the diver is relieved of all worry or concern about the apparatus. The man on deck "runs the exchange," so to speak. The gain in the speed with which the various diving operations are carried on with the aid of the telephone is remarkable. The weight of the apparatus is insignificant. The deck set weighs only about four pounds, and the diver's set adds only about eight ounces to the weight of the helmet.

THE ELIZABETH, N. J., TELEPHONE CO.

ONE of the best examples of an independent telephone exchange to be found in the East is that at Elizabeth, N. J. The Elizabeth exchange is young yet, less than a year old, but if it keeps on growing at the present rate it will before many years tax the energies of the best telephone engineering talent.

The distinguishing feature of the Elizabeth Telephone Company is its large list of stockholders, nearly all of whom are subscribers, thus making the concern almost wholly co-operative in its character.

The interests of the independent company are in the hands of James MacMaster, who fills the office of secretary, supported by a very efficient force of employés, who are made to feel that their own success depends greatly upon the success of the company. The system of accounts is of the simplest character, and so arranged that any officer of the company can at short notice at any time learn the condition of its finances. Mr. MacMasters believes in simplicity, and the doing of little things well.. The company now have 330 subscribers, and the list is growing rapidly.

One encouraging feature noted is that people are learning to use the telephone more, and the management believes there is no doubt that the time will come before many years have passed when the telephone will be on the desk of the merchant, the library table of the student, and even on the kitchen table of the housewife.

TROUBLE WITH THE RIVER AMAZON CABLE.

Consul Matthews writes the Department of State from Para that the Brazilian Government is having a hard time in trying to operate the new cable to Manaos. The cable, costing about $1,000,000, was guaranteed by the company for thirty days. On the thirty-first day it failed, and no message has been sent over it since last February. It is hoped to have it in working order by the end of the year. Engineers now assert that a cable up the Amazon cannot be made a success on account of the current and many obstructions in the river bed. The cable is of Siemens make, and one of the best ever laid, but the conditions are said to be worse than those encountered even by cables in the busy Hudson River.

IN A LONDON CHURCH.

A telephone has just been placed in the pulpit of St. Michael's, Chester square, in order that Canon Fleming's sermons may be heard by the inmates of the neighboring hospitals and by invalid parishoners.

SPOKANE, WASH.—The Spokane and Rossland Telegraph and Telephone Company has completed its first fifteen miles of line from Colville to Marcus and the instruments are being placed. The company will now push the work on the line both towards Rossland and Spokane, and hopes to connect the two cities by Jan. 1, 1897. A branch will also be built from Marcus to Grand Forks, connecting there with the local system of wires operated under the British charter. When this line is completed the whole mineral region lying in Stevens County, the reservation, and all the British Columbia mining camps will be connected up with and talk to Seattle direct.

LOCKPORT, N. Y.—The Bell Telephone Co. proposes to erect a new exchange at a cost of $10,000 and put its wires underground.

Roentgen Rays.

CURIOUS MOTIONS IN A CROOKES TUBE.

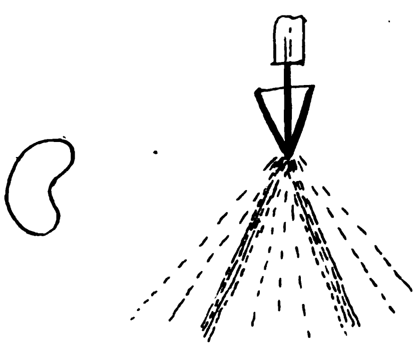
BY PROF W. C. PECKHAM.

WHILE making an exposure upon a patient with Röntgen rays a phenomenon occurred in the tube which seemed worthy of permanent record.

The tube was a Thomson double focus tube with adjustable vacuum, a most powerful tube, giving strong fluorescence and a flood of rays. At the time referred to there was lying on the bottom of the tube under the anode a crescent-shaped piece of glass, a thin cup-shaped sliver, which had been left in the tube during its manufacture. It lay on its rounded side like a watch glass lying on its convex side and was approximately a half inch long and a quarter of an inch wide. Fig. 1 represents its shape and size.

All at once it began to revolve and was soon whirling faster than the eye could follow, waltzing all by itself without a partner. After a little it came to rest. Again and yet again it went through this performance, stopping each time directly under the anode. Its next movement was to take a leap toward one of the anodes, to a distance of probably an inch and a half and immediately it jumped back again to its usual stopping place, alighting on its concave side, after which, of course, it lay still. This was seen by my patient as well as by myself.

In this tube the anode consists of a plate of platinum bent



FIGS. 1 AND 2.—CURIOUS MOTIONS IN A CROOKES TUBE.

into a V-shape. The tube was horizontal and placed so that the V was seen edgewise when looked down upon, and the piece of glass lay in the projection downwards of the bottom of the V. All who have used tubes whose anodes are the radiants of the X-rays, must have noticed in the fluoroscope the great difference in the intensity of the rays from the edge of the anode, giving a strongly shaded space as in the accompanying sketch, Fig. 2. This produces what I am accustomed to tell visitors is the only genuine X-ray.

The curious whirling of the piece of glass which was very thin and light indicates a greater intensity of action on one of its sides than the other. Or was it bombarded by material molecules driven out from the anode? By the way it was rendered visible in the dark room by its own fluorescence, it would not seem probable that cathode streams were the cause of this motion since there are focused on the anode about an inch above the piece of glass.

It might be that tubes could be constructed in which such a phenomenon could be produced with certainty by mounting a light vane of some dielectric directly under the edge of a V-shaped anode.

On the following day the piece of glass which had behaved with so much levity was found broken into several fragments, and has not done so any more.

THE PHOSPHORESCENCE OF FLUORESCENT SCREENS.

BY MARTIN P. RICE.

Referring to the subject of phosphorescence of fluorescent screens the following experiment affords a good illustration:

A Crookes tube, giving an abundant supply of Roentgen rays of high penetrative power, was excited by a powerful induction coil. A flat iron wrench was then placed against the screen of a fluoroscope and viewed in the usual way. On opening the switch in the primary the bright illumination of the screen ceased, but a very perceptible glow continued, making the dark shadow under the metal object plainly visible, although the tube was no longer excited.

After the primary circuit is broken, the metal object may be removed entirely from the screen, but its shadow will still appear surrounded by the glowing surface. If a completely darkened room is available for the experiment, the screen, after receiving the impression, may be handed around and viewed by different persons.

A number of different fluoroscopes were tested in this way for fluorescence, and all were found to possess the property to a greater or less degree.

X-RAYS HARMLESS WITH THE STATIC MACHINE.

BY G. A. FREI.

LAST summer I had a communication published in one of the electrical journals regarding the deleterious effect of the rays on the skin. As I said then, I have always been skeptical on the subject and at the time admitted the fact against my own convictions. With what I thought then to be the effects of the rays on my own hands it was practically a natural conclusion.

Since then I have persistently kept on with my experiments in that line and finally came to the conclusion that the effects which we perceive on the skin, the hair or nails, are not caused by the action of the X-rays in any way.

During last summer, and before the publication of my former communication, I carried on the experiments mostly with a 6-inch Ruhmkorff coil, reinforced at times by a step-up coil. Since then, however, my experiments were made almost exclusively with static machines, averaging an 8-inch continuous discharge. More time is devoted to them than last summer, and the apparatus is more powerful than that used at that time, yet neither myself nor any of the persons I ever experimented upon with the static machine have ever felt any ill-effects.

The remark has been made that possibly by this time the skin on my hands may not be so sensitive to the action of the rays and that therefore no effects are shown. To find out whether there can be such a thing as X-ray-proof skin, and at the same time whether there is really no bad effect on the skin when static machines are used for the production of X-rays, I started a series of experiments with my left foot. For several weeks I subjected it to the action of the rays every four days from half an hour to an hour at a time. The tube was brought as near the foot as possible without touching it, but up to the present there is neither discoloration nor any other of the now well-known effects to be seen or felt. This proves conclusively, at least as far as my own observations goes, that whatever ill-effects we get on our skin are caused only when we use induction coils of one form or another, while no such effects are perceived when we employ the static machine.

Many physicians bring forth the argument that the application of the X-rays might prove dangerous to their patients, that here a foot had to be amputated, then some one's finger nails dropped off, another has a sore of three months' standing, etc. Such arguments can be met with the above fact that the X-rays are not the direct cause of the trouble and with this fact established remedies could undoubtedly be found to reduce, if not entirely eliminate, the effect on the skin when coils are to be employed.

Letters to the Editor.

THERMO-ELECTRICITY AND THE JACQUES CELL.

Prof. W. A. Anthony, in his letter to The Electrical Engineer, published Dec. 9, appears to have misinterpreted some of my statements in regard to the nature of the action in the Jacques battery.

Had I stated that the electrical energy of the cell was produced by the conversion of heat into electrical energy, the objection raised by Prof. Anthony to the thermo-electric theory would be applicable. What I stated was that if the current obtained corresponds exactly to the electro-chemical equivalent of the carbon consumed and the carbon dioxide produced, the action is thermo-electric and the oxidation of the carbon is due to the electrolytic action of the thermo-electric current. There is nothing in this statement to imply that the energy of the carbon is, by electrolytic action, converted into heat. On the contrary, the energy of the carbon must, by electrolytic oxidation, as in the electrolytic oxidation of all other substances, be added directly to the energy of the electric circuit without the evolution of any heat and without passing through the form of heat; or, as stated by me, "the energy of the carbon would be consumed in maintaining the electromotive force on closed circuit." On open circuit no carbon would be consumed. C. J. REED.

Philadelphia, Pa.

THAT LONDON "REVIEW" CRITQUE.

I HAVE always admired the quiet way in which The Electrical Engineer goes about its work and attends to business without bothering itself as to criticism from some contemporary or other which thought it had a point to make, showing its smartness. I was glad, however, to see you depart for once from your usual reserve in this respect and administer a well-deserved rebuke to the snobbish and snarling London Electrical Review, whose consciousness of its own superiority is a painful thing to witness. If this attempted criticism on your article had been written by the Review's office boy, I would recommend the discharge of the boy as being unfit for his position, for it seems to me that there must be something gone wrong when a paper so loses its self-respect as to attempt to hold people up to ridicule by mere word quibbling and pure lack of information. In regard to the first item which troubles The Review I will mention for their benefit, and also for the benefit of the blue-covered echo on this side of the water who copied the article, that by referring to any elementary treatise on steam, they will find that the engine is just as much considered a "consumer" of steam as the furnace is a "consumer" of coal. Although this word quibble is hardly worthy of notice I am constrained to quote higher authority, viz.: Haswell's Hand-book, page 724. "In cases of locomotives and portable engines consumption of steam per horse power is" * * *. There are many other references of the same nature. In regard to the other point which the Review finds itself befogged, the writer says: "Considering that the engine drives the dynamo, and not the dynamo, the engine, it is difficult to see where the shock is to come from." This reminds us of the remark of the Irishman, who fell from a building. On being asked if he had been hurt by the fall, he said: "No, sure, it wasn't the fall that hurt me at all. It was the sudden bang agin the earth that nearly done me." In other words, if the man had had the cushioning effect of a spring mattress to fall upon, he would not have been hurt; or, if he had been built larger and stronger, he no doubt would have escaped with a bruise or two.

On the same principle, the success of our modern direct coupling plants is no doubt due largely to the increased size and strength of the engine, so constructed as to withstand the sudden changes of load, such as are daily experienced in railway work wherever there is an electric railway. If the Review's writer still fails to see this point, I would suggest if he will come over here, where there are a few electric railways, I will be glad to show him around, so he can see for himself the point of my remarks.

As to other portions of this attempt to criticise, they are unimportant, with the possible exception of efficiencies, which are too well known to need comment. I would say that while I am quite sure the Review does not pose as a comic paper, you are warranted in saying that the sneer intended to be raised at your expense has resulted as a boomerang on this side of the water, and furnished much amusement to the average American who has noticed the Review's peculiar remarks. R. M.

Brooklyn, N. Y., Dec. 16, 1896.

THE GOVERNMENT BELL SUIT.

There seems to be a great deal of misapprehension in the electrical press regarding the recommendation of Attorney General Harmon, that the "Bell suit" be dropped. Some of your contemporaries are outraged at the impropriety of the Attorney General's attempting to forestall the decision of the Supreme Court in the Berliner case, forgetting apparently that previous to the institution of the Berliner suit, the government brought suit to annul the Bell patents. That was in the days of Attorney General Garland, "Prof." Rogers, and "Pan Electric" telephone. You may remember that the Bell patents expired before the suit to annul them came to final hearing, despite which fact the government went on taking testimony, as I am informed, but apparently to no good purpose, in the opinion of the present Attorney General.

G. D. GATES.

New York, Dec. 18, 1896.

INDUCTION IN NEIGHBORING WIRES.

Can any of your readers give the following information through your journal:

If we have two metallic circuits on same routes, equally and well insulated, what current will be induced into one circuit by the other, considering distance between them to enter into problem:

First: When both circuits are copper. Second: When both circuits are iron. Third: When one circuit is copper and the inducing current is iron. Fourth: When one circuit is iron and the inducing circuit is copper. ROBT. C. MATLOCK.

Springfield, Ill.

SOCIETY AND CLUB NOTES.

THE ROENTGEN RAY BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE meeting of the Institute, held on Dec. 16, was devoted to a discussion of the "Roentgen Ray in Its Relation to Physics," and the announcement served to bring out a large attendance of members.

The discussion was opened by Prof. H. A. Rowland, who gave a brief account of the various explanations that had been given as to the source of the Roentgen rays. The first, which was that put forward by Roentgen himself, was that the source was the point where the cathode rays strike. Prof. Rowland had found that it was the anode, and in one of his tubes the radiating spot was only 1-1000th of an inch in diameter. Prof. Rowland then described various experimental tubes which he had made, and found that the rays were most abundant when the cathode rays were focussed on the anode, as in the focus tubes. Prof. Rowland then raised the question whether the rays were still Roentgen rays after they strike an object.

The speaker then passed in review the various physical properties of the ray. He was not positive that the rays were regularly reflected. The magnet does not affect them. Neither could they be prolonged. J. J. Thomson had shown their effect on gases which became conductive under their influence, but the gas loses this power after a short exposure. We were still in doubt as to whether the rays were homogeneous, or whether they were like light rays, which could be broken up into a spectrum. Porter had found that he could make some kinds of X-rays penetrate the bodies better than others.

Regarding the theory of the X-ray in its relation to the ether, Prof. Rowland said that the problem was too complicated for a successful solution in the present state of our knowledge. Experiments he had made showed the rays to have a wave length one-seventh that of yellow light. Others found it to be one-thirtieth; but there was as yet no positive evidence that they were, or were not waves. As to the non-success thus far in reflecting the X-ray, Prof. Rowland thought that this might be due to the fact that the surfaces heretofore employed were too rough. While one theory held the X-rays to be composed of very short waves, another attributed them the waves similar to those of sound; but they were both open to the same objection—namely, that the waves are stopped by the molecule with which they come in contact. According to Maxwell sound waves cannot exist in the ether. He did not believe the impulsion theory put forward by Prof. Stokes to be correct. If it were, any single impulse would be thrown into the shadow, and no such sharp definition as is obtained in Roentgen ray photographs could be had. He also mentioned the vortex ring theory of Prof. Michelson.

In conclusion, Prof. Rowland said that hundreds of years of speculation on the nature of light had not yet enabled us to formulate a comprehensive theory regarding it, and how could one expect the Roentgen ray to be fully explained in less than one year?

Prof. Elihu Thomson did not agree with Prof. Rowland that no X-rays were produced, except when the cathode rays struck the anode. He had insulated a piece of metal in a tube which became the source of the X-rays. He believed that when the cathode rays strike a solid body, such as platinum, and are directed, they produce X-rays; but if they become diffused, no such rays are produced. He had found the various forms of induction coils and static machines to give equally good results, but the static machine to be the most powerful, however. He believed this to be due to the fact that the action of the coil was intermittent, while that of the static machine was continuous; for the same reason he had found the single focus tube better adapted for the static machine, and the double focus tube better with high-frequency alternating coils.

The most effective manner of exciting an X-ray tube Prof. Thomson had found to be one devised by Mr. Herman Lemp. A 12-inch coil was employed and the primary excited by alternating current of 125 cycles. That gave an increased potential in the secondary equal to a 6-inch spark between the terminals. This high potential discharge in the secondary, of course, was an alternating current. He then employed a

break-wheel, so arranged as to pick out the tops of the waves of one direction only, so as to give a unidirectional discharge. The discharges so produced, 125 per second, are wonderfully uniform and their effects most powerful. Unless carefully handled they melt down the platinum in the tube in short order. Thus he had melted a hole through a piece of platinum one-thirty-second inch t..ck in three seconds, and through three-sixteenths inch iron in a high vacuum.

The penetrating powers of the X-rays so produced were also very powerful. The rays penetrated through one-quarter-inch of wrought iron, and he could read the letters of a name plate on an iron casting, nine-sixteenths inch thick, by the aid of the fluoroscope.

Prof. Thomson was also of the opinion that there were varieties of the X-rays. He had found that low vacuum tubes become vigorous when a condenser is placed around the spark gap. He had also tried to ascertain whether the X-rays were diffused or radiated from one body to another, but had obtained negative results.

Coming to the effects of the X-ray on the tissues, Prof. Thomson recounted the experiment he had made on himself by exposing the little finger of his hand to the rays for thirty minutes, described by him in The Electrical Engineer of Nov. 18 and 25. This experiment was carried out with a blue glass tube, having a clear glass window. The effects were very marked, causing the blistering and loss of the skin, and Prof. Thomson, after six and a half weeks, still carried a bandage on the finger. He did not believe the result was due to static effect. He was strengthened in this belief by the fact that a patient, now under treatment in the hospital, had received X-ray "burns" through the clothing. Prof. Thomson also tried to ascertain whether the X-rays would have the effect of causing the falling out of the hair of animals. He subjected a mouse to the influence of the rays, but the experiment was cut short by a cat, to whom the mouse fell a victim.

Prof. M. I. Pupin detailed his experiments on the Roentgen ray, and stated that he had found better effects to be produced when a large amount of energy is sent through the tube at comparatively long time intervals, than a smaller amount at shorter intervals. He also described a method for studying the diffusion and reflection of the rays, and entered into the theory of the subject.

Mr. A. E. Kennelly and Mr. Max Osterberg also discussed the subject briefly.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the last meeting of the Council of the American Institute of Electrical Engineers the following associate members were elected: Charles Hamen Adae, X-ray laboratory, P. O. box 2,809; residence, 36 Thirty-fifth street, New York City. William W. Blunt, electrical engineer, Westinghouse Electrical and Manufacturing Company, Ltd., 32 Victoria street, London, England; Robert A. Byrnes, 98 Ferry street, Lafayette, Ind.; John Jay Crain, electrician's helper, Niagara Falls Power Company, Niagara Falls, N. Y.; Henry H. Humphrey, consulting electrical engineer, Bryan & Humphrey, Turner Building, St. Louis, Mo.; Dr. Erasmus Kittler, Elektrotechnisches Institut, Darmstadt, Germany; Harry Milton Latham, member of engineering staff, Crocker-Wheeler Electric Company, Ampere, N. J.; Robert Stuart Stewart, superintendent of Lines Public Lighting Commission, 440 Jefferson avenue, Detroit, Mich.; Frank Sutton, consulting engineer, 27 Thames street, New York City.

The following institute associate members were transferred to full membership: O. P. Loomis, electrical engineer, Bound Brook, N. J.; A. M. Schoen, electrician, Southeastern Tariff Association, Atlanta, Ga.; H. G. Field, consulting electrical engineer, Detroit, Mich.; S. G. McMeen, engineer, Central Union Telegraph Company, Chicago, Ill.; J. W. McCrosky, electrical engineer, La Capital Tramway Company, Buenos Ayres; S. B. Fortenbaugh, assistant professor of electrical engineering, University of Wisconsin, Madison, Wis.; Lee Hamilton Parker, assistant engineer railway dept. General Electric Company, Schenectady, N. Y.; H. M. Brinckerhoff, electrical engineer, Metropolitan West Side Elevated Railroad, Chicago, Ill.

CHICAGO ELECTRICAL ASSOCIATION.

The Chicago Electrical Association elected officers on Dec. 18, as follows: S. G. McMeen, president; F. S. Hickok, vice-president; E. J. Jenness, treasurer; H. Cochrane, auditor; W. Clyde Jones, G. W. Knox and K. B. Miller, directors; J. R. Cravath (re-elected), secretary and librarian. A paper was read by Mr. Jenness on Decorative Lighting.

OBITUARY.

HARVEY LAMB LUFKIN.

IT is with deep sorrow and regret that we receive the news as we go to press of the death of Mr. H. L. Lufkin, the manager of the Crocker-Wheeler Electric Company, from appendicitis. He had just returned from a long and successful Western trip, and had not yet been home long enough to resume his regular work at the office when he was taken ill and was removed to Mt. Sinai Hospital. An operation was performed, but peritonitis set in and about 10 a. m. on Monday he died quietly. The news comes as a shock to a host of friends in the electrical and other fields.

Mr. Lufkin was still young, having been born in Cleveland, O., in 1857. About fifteen years ago he became interested in electrical matters, and was active in placing a small ozone machine on the market. He became acquainted with Dr. S. S. Wheeler and Prof. F. B. Crocker, at that time beginning the

HARVEY L. LUFKIN.

manufacture of small motors, and was tremendously impressed with the possibilities. He joined them in the C. & C. Motor Company and did some admirable work, far beyond that of the ordinary commercial character. He had a clear mental conception of the problems presenting themselves, and his papers, such as those contributed to the National Electric Light Association, were of the first order of genuine merit and usefulness. In 1892, Mr. Lufkin retired from the C. & C. Co., and rejoined his former associates above mentioned, who had meantime founded with great success the Crocker-Wheeler Electric Co. At that time their product was limited to motors and dynamos not exceeding 5 horse-power, but a recent contract, involving 1,000 horse-power in units of 100 horse-power gives an idea of the growth of the company under Mr. Lufkin's active and intelligent business management. Some of the earliest and largest motor driven plants in this country stand as monuments to his enthusiastic advocacy of the development to which he may be said to have devoted his life.

Mr. Lufkin was a man of most agreeable personality, generous, social instincts, and ready willingness to assist in any object for the welfare of electrical interests. He was one of the leading spirits in the successful Electrical Exposition held in this city last May, and took part in other enterprises and movements of kindred nature. It is needless to say that his services were highly valued by those with whom he had so long been associated, and that the business relation had grown into a close personal friendship, strengthened by the feeling and recollection of early struggles together in promoting the new great industry of electric power.

Mr. Lufkin leaves a widow, to whom the condolence of the entire profession is extended; while it is felt by his old colleagues that they also have sustained an irreparable loss.

DAVID LEONARD BARNES.

David Leonard Barnes, consulting engineer, died in this city on Dec. 15. His name had become well known to the public within the last year as that of the consulting engineer to the Baldwin-Westinghouse combination for building electric locomotives. In the service of those companies, Mr. Barnes designed a set of standard electric locomotives for a variety of

service, and two or three of these locomotives have already been built.

Mr. Barnes was a member of the Am. Soc. of Civ. Engrs., the Am. Soc.. of Mech. Engrs., the Inst. of Civ. Engrs. of London, the Western Soc. of Engrs. and various other scientific and technical bodies. He was a member of the Union League Club of Chicago, the Manufacturers' Club of Philadelphia and the Engineers' Club of New York.

Mr. Barnes was born near Providence, R. I., Aug. 23, 1858, and was educated at Brown University and the Massachusetts Institute of Technology. He had received the degree of master of arts from Brown University. He took special interest in the latest electric railway problems, and contributed to the columns of the Railroad Gazette, The Electrical Engineer, etc., some very valuable articles on the subject.

MR. JOSEPH R. THOMAS.

The death is announced, we regret to say, of Mr. J. R. Thomas, who, since 1883, had been the editor of the well-known technical paper, The American Gas Light Journal. He was a practical gas engineer and manager, and was president of the Society of Gas Lighting in 1875.

Patent Notes.

THE LEONARD SYSTEM OF REGULATION BY SEPARATE E. M. F.

A patent was issued Dec. 8 to Mr. H. Ward Leonard (No. 572,903), covering broadly the use of an independent, positive and controllable electromotive force in the circuit of a motor armature for the purpose of varying the speed of the electric motor. The form of apparatus particularly described in the patents develops an e. m. f. in the motor armature circuit, which is not only variable but also reversible.

While the invention is described in the patent with special reference to its applicability to the control of motors, the patent claims are, in many instances, not limited to motors, but are broad enough to cover the regulation of the e. m. f. upon the terminals of "translating devices" of any kind by the introduction of a positively controllable e. m. f. in the circuit leading to the translating device.

Many of the claims are apparently broad enough to cover such forms of "boosters," now in use, as have a shunt-wound motor driving the "booster" armature, the "booster" armature being in a field which can be regulated at will. The claims of the patent are especially broad, where the e. m. f. of the "booster" armature is so arranged that it cannot only be made to "boost," but also to act counter to the main e. m. f., and thus reduce the e. m. f. at the translating device below that of the source.

There were many claimants for this patent before the Patent Office. In the several inferences, extending over many years, there were such familiar names as Wheeler, Lundell, Hunter, Woods, Wightman, Burke, Bancroft, Blauvelt, etc., indicating a general appreciation of the value of the invention.

This is the last of a series of patents which have been issued to Mr. Leonard on the line of regulation by a separate e. m. f. instead of ohmic resistance, the value of which method he seems to have been first to appreciate clearly.

It is gratifying to learn that this patent is not to be used to force the sale of the apparatus of some particular manufacturer, but will be open to use by anyone under reasonable terms.

Personal.

MR. W. W. LOW, of Chicago, was a visitor to New York last week and was gladly welcomed by a host of friends, who see him here far too seldom.

BENJAMIN FRANKLIN will be the subject of an article by Prof. Treat, of the University of the South, in McClure's Magazine for January. It will be illustrated by fifteen fine portraits, some of which have never before been published.

MR. G. P. LATHROP has begun in the Sunday New York "Press" a very imaginative piece of fiction entitled: "In the Deep of Time." It is based to some extent on notes and suggestions as to new possibilities in invention, furnished by Mr. Edison in a series of conversations.

MR. W. RUTHERFORD, who for some years past has done admirable work as the chief engineer of the Canadian General Electric Company, is about to return to England to take up residence permanently as engineer in charge of the electric railway department to be formed by Dick, Kerr & Co., the great street railway contractors. We regret greatly that a young man of Mr. Rutherford's talent should leave the country, but his going to England is another indication of the coming electric railway régime there, and is for that reason to be hailed as a good sign.

MR. J. D. PARSONS.—The Board of Directors of the Union Traction Company, of Philadelphia, has elected John D. Parsons of Chicago as vice-president and general manager of the company, to take effect at once. Mr. Parsons was vice-president and general manager of the West Side Chicago Street Railway.

MR. GEORGE W. CONOVER has resigned his position as Western manager of the Perkins Electric Switch Manufacturing Company, Hartford, Conn., to take effect Jan. 1, 1897. Mr. Conover, is very well known in electrical circles throughout the West, and although he is not yet ready to announce what his future plans will be, he intends to remain in touch with the interests with which he has been so closely identified for several years past.

MR. J. R. BEETEM has resigned as general manager of the Union Traction Company, of Philadelphia. Mr. Jas. Brocker, once a street car conductor, who has risen by sheer merit, assumes a large part of his duties, in arranging schedules for the running of the cars.

MR. C. D. WYMAN, general manager of the Milwaukee Electric Light and Railway Company, has been elected general manager of the New Orleans Traction Company, under a scheme of reorganization.

Legal Notes.

THE HAITI CABLE NOT ENJOINED.

Judge Lacombe, of the United States Circuit Court, has denied the motion for a preliminary injunction in the suit of the United States against La Compagnie Francaise des Cables Télégraphiques, the United States and Haiti Telegraph and Cable Company and the United States and Haiti Cable Company. The suit was brought to prevent the defendants from laying and landing at Coney Island a telegraphic cable between this country and Haiti, without the consent of the Government, and a motion was made for a preliminary injunction upon a bill of complaint and affidavits.

In his decision Judge Lacombe says:

"The laying of the cable was completed before this motion was submitted, and there is nothing to show that its operation until final hearing will produce irreparable injury to the United States or to any individual. It is thought that without the consent of the General Government, no one, alien or native, has any right to establish a physical connection between the shores of this country, and that of any foreign nation. Such consent may be implied as well as expressed, and whether it shall be granted or refused is a political question, which, in the absence of Congressional action, would seem to fall within the province of the Executive to decide.

"It is further thought that the Executive may effectually enforce its decision without the aid of the courts, and it is certainly indisputable that Congress has absolute authority over the subject. That body is now in session, and if any urgent necessity not disclosed in the papers before the court should call for immediate action, it can settle the question of assent or non-assent with such definiteness as to leave no further room for argument."

CARBORUNDUM LITIGATION.

A suit alleging infringement of the patent on the Cowles electric furnace has been recently brought to an issue by the Cowles Electric Smelting and Aluminum Co., of Lockport, N. Y., and Alonson T. Osburn, trustee, against the Carborundum Company, of Niagara Falls. The argument was begun on Dec. 7 before Judge Joseph Buffington, of the United States District Court. One thousand four hundred pages of expert testimony have been taken since the suit was entered in 1894.

Alfred H. Cowles claims that the electric furnace used was his discovery, and that he had made carborundum in 1885. This he did not know, however, it is claimed, until 1894, when specimens containing carborundum, which had been placed in the Boston Museum, were produced. The entire part of electric furnaces in electro-metallurgy was claimed. The present suit asks for an injunction to prevent the Carborundum Company, which operates under the patents of the well-known inventor, Mr. E. G. Acheson, from

using the furnace. The defense bases its claim on non-interference.

Attorneys George H. Christy and Thomas and William Bakewell represent the defense, and E. N. Dickerson, the New York attorney of the Bell Telephone Company, and C. M. Vorce, of Cleveland, are counsel for the plaintiff.

The Carborundum Company is a Pittsburg concern. It was started at Monongahela City several years ago, but the business grew so rapidly that a larger plant was built last year at Niagara Falls and use was made of the cataract power. Pittsburg capital controls the business, and Andrew W. Mellon and R. B. Mellon, of that city, are principal directors.

ONE CENT'S WORTH OF ANGUISH.

The general rule of law that an action for damages may not be maintained for mental pain and anguish unconnected with or that do not cause physical injury, was followed by Judge Morris in the United States District Court, in Baltimore, on Monday. The action of John R. Treganowan, an artist, against the Western Union Telegraph Company for $5,000 for the "great mental pain and anguish" he was caused to suffer for the failure of the company to deliver a telegram some days before his wife's death, that she was dangerously ill, was taken from the jury, which rendered a verdict, by direction of the Court, for Mr. Treganowan for 1 cent.

TROLLEY CAR SPEED.—APPELLATE DIVISION SUSTAINS AN ORDINANCE OF THE BROOKLYN ALDERMEN.

The Appellate Division of the New York Supreme Court has rendered a decision upholding the validity of the trolley speed ordinance adopted a couple of years ago by the Brooklyn Board of Aldermen. In a test case Civil Justice Neu held one of the trolley companies responsible for violating the ordinance, and imposed a fine of $25, but County Judge Aspinall reversed his decision. The Appellate Court has now sustained Justice Neu.

The ordinance provides for the running of the cars at various rates of speed within the city limits, and it is the intention of the authorities strictly to enforce it. The case will now probably be carried to the Court of Appeals.

ADMISSION OF X-RAY EVIDENCE IN A DENVER MEDICAL SUIT.

In a suit at Denver, for medical malpractice, Judge Le Fevre ruled for the admission of X-ray photographs, and said: "During the last decade, at least, no science has made such mighty strides forward as surgery. It is eminently a scientific profession, alike interesting to the learned and unlearned. It makes use of all science and learning. It has thus been of inestimable service to mankind. It must not be said of the law that it is so wedded to precedent that it will not lend a helping hand. Rather let the courts throw open the door to all well-considered scientific discoveries. Modern science has made it possible to look beneath the tissues of the human body, and has aided surgery in telling of the hidden mysteries. We believe it to be our duty in this case to be the first, if you please to so consider it, in admitting in evidence a process known and acknowledged as a determinate science. It may solve a present condition. The exhibits will be admitted in evidence."

FIGHTING THREE-CENT CAR FARES IN CHICAGO.

An ordinance calling for a four-cent fare on all the street car lines in Chicago has passed the City Council. The vote was overwhelmingly in favor of the ordinance. In case the Mayor vetoes the ordinance it is said it will be passed over it by the Council. There were many who favored a three-cent fare. The street car companies will fight the ordinance, and their lawyers are already working to that end.

DUTIES OF STREET CAR CONDUCTORS.

The Superior Court, at New Haven, Conn., on Nov. 10, in a suit for damages, gave a decision, holding that except in exceptional conditions of danger a conductor is not bound to assist a passenger in alighting from a street car.

RAILWAY LINE DETAIL LITIGATION.

The General Electric Company has just brought five suits against the Fiberite Company, of Mechanicville, N. Y., manufacturers of the Medbery Insulation and Overhead trolley Equipment, for alleged infringement of patents owned by them, on "suspension devices and ears" for trolley roads. These suits will be watched with much interest, by all electric roads not using G. E. equipment, and by all manufacturers of overhead devices. The Fiberite Company propose to defend this suit vigorously.

NEWS AND NOTES.

MOTOR NAME PLATES.

It is worth pointing out that according to Rule 8, Section F, of the New York City Fire Department, motors must have the speed, voltage, and amperes, or the normal capacity in horsepower, stamped in plain figures, on the iron work of each motor, where they can be readily seen. This would seem to bar out name plates, the object being to prevent deception which might lead to overheating a motor.

MR. TESLA ON THERMO ELECTRICITY.

In a letter to the editor of the Buffalo Enquirer, Mr. Nikola Tesla replies as follows in regard to an inquiry on the subject of the future of electricity:

"The transmission of power has interested me not only as a technical problem, but far more in its bearing upon the welfare of mankind. In this sense I have expressed myself in a lecture, delivered some time ago.

"Since electrical transmission of energy is a process much more economical than any other we know of, it necessarily must play an important part in the future, no matter how the primary energy is derived from the sun. Of all the ways the utilization of a waterfall seems to be the simplest and least wasteful. Even if we could, by combining carbon in a battery, convert the work of the chemical combination into electrical energy with very high economy, such mode of obtaining power would, in my opinion, be no more than a mere makeshift, bound to be replaced sooner or later by a more perfect method, which implies no consumption of any material whatever.

NEW RAILS FOR THE B. & O. S. W.

The Baltimore and Ohio Southwestern Railroad has made a contract with Carnegie & Co. for 7000 tons of steel rails, 75 pounds to the yard, for immediate delivery. The rails will cost somewhere in the neighborhood of $200,000 and will be delivered about the first of December.

X-RAYS HELP TO RELIEVE SUFFERING.

Many people have applied recently to Supt. Meadowcroft, of the Edison Lamp Works, Harrison, N. J., to locate splinters, needles, etc., in their hands and feet. On two occasions he has done so by means of the X-rays, having a plant of that kind in the factory. Mrs. Margaret Englemyer, a dressmaker, had a broken needle in her left thumb, and went to the works recently. The position of the needle was located by the X-rays, and it was removed.

THE NEW PLAY "THE ELECTRICIAN.

We are in receipt of the subjoined item as to the new play of Mr. C. E. Blaney, called "The Electrician":

"Rehearsals for 'The Electrician' will be called about January 1, and Chas. E. Blaney and Manager Crossley are busy arranging for this mammoth production. The scenic and electrical effects are the most elaborate that have been attempted in years. The first act, showing a banking house in Denver during the busy hours, is the most complete as to scenery and details that has ever been put on any stage. Act second, with its large dynamos actually running by steam and generating electricity and lighting the stage and city in the distance, is one of, if not the most, realistic scenes ever offered the public in a dramatic production. The killing of the inventor by the villain pushing him upon a live wire, and the fall of a lineman from the top of a pole, after receiving a shock, are realistic and perfectly consistent with the natural action of the piece. The Palace Hotel, Cripple Creek, scene in act third, introduces an entirely new type of characters and surroundings. Rough miners, gamblers and typical Westerners, are all making merry on Christmas Eve, with the tenderfeet from the East, while Nell, the belle of Cripple Creek, sings and dances for their amusement. Act fourth shows the ball room and parlors of the ——— Hotel, Denver, during a reception given by Edwin Palmer, the Gold King, to his friends. The finish of this act, contrary to the usual fourth act finish, is one of unusual interest, as the villains are discovered dead behind a screen, where they were scheming for the destruction of the hero—the victims of their own plot"

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS, ISSUED DECEMBER 15, 1896.

Alarms and Signals:—

INDICATOR OR SIGNAL. J. P. Coleman, Swissvale, Pa. 573,207. Filed June 29, 1896.

A case supporting bars having one end secured in the case, sleeves adapted to fit over the bars, and signal operating mechanism supported by the sleeves.

ELECTRIC SIGNALING APPARATUS. F. B. Herzog and S. S. Wheeler, New York, 573,221. Filed Jan. 25, 1896.

Comprises two or more separately variable transmitting mechanisms, each including a motor, together with shifting devices.

Conductors, Conduits and Insulators;—

INSULATOR. F. M. Locke, Victor, N. Y., 573,092. Filed Aug. 24, 1896.

An insulator comprising two members, the outer one composed of insulating material puncturable by an electric current, and an inner member of less puncturable insulating material.

WALL INSULATOR. J. J. O'Neill, Boston, Mass., 573,101. Filed Dec 19, 1895.

Consists of a tapering member provided with a lug forming a stop, and a hooked insulated member extended from the tapering member intermediate at its ends.

ELECTRIC CABLE. F. Borel, Cortaillod, Switzerland, 573,176. Filed Jan. 7, 1896.

Consists of a conductor of copper, and intervening asbestos forming the insulating material.

AUTOMATIC GROUNDING DEVICE FOR ELECTRIC CONDUCTORS. G. A. Jewett, Chicago, Ill., 573,222. Filed Dec. 6, 1895.

In connection with a conductor a contact device normally open, but arranged to be closed by gravity in case of breakage of the conductor.

CONDUCTOR OF ELECTRICITY AND CONDUIT FOR HOLDING SAME. A. Selkirk, Albany, N. Y., 573,302. Filed Jan. 30, 1896.

Details of construction.

WIRE JOINT. C. E. Brown, Chicago, Ill., 573,386. Filed Oct. 11, 1895.

Consists of a sheet of metal foil rolled so as to form two rolls, without the use of solder or brazing that will completely cover the wires at the joint.

Dynamos and Motors:—

DIRECT CURRENT DYNAMO ELECTRIC GENERATOR. B. G. Lamme, Pittsburg, Pa., 573,009. Filed March 11, 1896.

A parallel-wound armature for multipolar direct current machines provided with alternating current connections between points in its winding of normally equal potential through which leading and lagging currents may be transmitted to equalize the magnetic circuits of the machine.

COLLECTING BRUSH. E. B. Raymond, Schenectady, N. Y., 573,105. Filed Aug. 5, 1896.

Composed of a core of conducting material surrounded by insulation.

SECURING FIELD MAGNET POLES. H. G. Reist, Schenectady, N. Y., 573,107. Filed Aug. 24, 1896.

The pole pieces are composed of laminated material and are dovetailed into the periphery of the revolving structure.

ATTACHING FIELD MAGNET POLES. F. O. Blackwell, Schenectady, N. Y., 573,130. Filed Aug. 24, 1896.

Similar to above.

Electric Furnaces and Heating:—

ELECTRIC FURNACE. M. Schindler, Neuhausen, Switzerland, 573,041. Filed Aril 23, 1896.

Means for cooling the electrode holders, and the electrodes.

ELECTRIC BOILING APPARATUS. J. W. Schindler-Jenny, Kennelbach, Austria-Hungary, 573,042. Filed Feb. 27, 1894.

Consists of a water tight hollow body in which electric conductors are enclosed between rings or discs of non-conducting fireproof material.

ELECTRIC SOLDERING CLUB. P. Stotz, Stuttgart, Germany, and F. W. Schindler-Jenny, Kennelbach, Austria-Hungary, 573,245. Filed Jan. 14, 1895.

Details of construction.

Electro-Metallurgy:—

PROCESS OF PRECIPITATING PRECIOUS METALS FROM THEIR ALKALI CYANIDE SOLUTIONS. M. Netto, Almazarron, Spain, 573,233. Filed March 16, 1896.

Consists in acidulating the alkali cyanide solution containing the metals by hydrochloric acid so as to precipitate silver chloride, separating the precipitated silver chloride by filtration from the solution, and subjecting the acid filtrate to the action of an electric current so as to deposit the gold on the cathode.

Lamps and Appurtenances:—

ELECTRIC SIGN. F. H. Hawkins, New York, 573,088. Filed Jan. 13, 1896.

Comprises a vacuum chamber having two transparent faces and also having a longitudinal central partition wall, filaments of carbon arranged in said chamber on opposite sides of the partition wall and shaped to form a letter, and conductors connected to the filaments.

ELECTRIC ARC LAMP. C. Richter and R. T. Eschler, Camden, N. J., 573,161. Filed March 26, 1896.

Comprises a cup and arc inclosing chamber, and a coiled spring, the latter being reeved in the cup, and engaging the chamber to yieldingly support it.

ELECTRIC ARC LAMP. C. Richter and R. T. Eschler, Camden, N. J., 573,162. Filed April 9, 1896.

Consists of an electric arc lamp of the clutch type, in which the brass carbon rod is dispensed with.

COMBINATION GAS AND ELECTRIC FIXTURE. J. E. & W. M. Brown, Toledo, Ohio, 573,387. Filed July 2, 1896.

Combines a service pipe, a fixture suspended and supported by means independent of the service pipe, and an insulated coupling interposed between fixture and service pipe.

HEADLIGHT FOR ELECTRIC CARS. J. H. Neal, Boston, Mass., 573,283. Filed July 10, 1895.

The front of the headlight is substantially flush with the dashboard.

ELECTRIC ARC LAMP. A. C. Dobrick, Chicago, Ill., 573,398. Filed June 13, 1896.

Clutch for holding carbon.

Measurement:

ELECTRIC METER. W. D. Marks, Philadelphia, Pa., 573, 021. Filed Oct. 20, 1896.

Comprises a controlling amperemeter and means for automatically tapping the amperemeter.

WATTMETER. T. Duncan, Ft. Wayne, Ind., 573,078. Filed April 29, 1896.

Comprises an armature and a field magnet, a shunt core arranged with one end intersecting the axis of the field magnet, and a shunt coil wound upon the opposite end only of the core.

METER FOR MEASURING ELECTRIC CURRENTS. T. Duncan, Ft. Wayne, Ind., 573,079. Filed May 7, 1896.

The combination with the meter sindle, of a multiolar permanent magnet having radiating limbs, and a fixed paramagnetic ring surrounding the outsetting poles of the magnet in close proximity thereto.

ELECTRIC METER. T. Duncan, Ft. Wayne, Ind., 573,080. Filed July 2, 1896.

Consists of a disc armature comprising a plurality of segment-wound coils lying flatwise in the disc with their arcs toward the periphery, in combination with segment-wound series coils laid parallel with the plane of the disc with their arcs overlying the arcs of the armature coils.

ELECTRIC METER. C. Erben, Berlin, Germany, 573,082. Filed Oct. 10, 1895.

Employs an oscillatory balance spring of a clockwork with a counter spring connected to its outer end magnets, and means for causing the magnets to control the arc of oscillation of such counter spring.

Miscellaneous:

RESONATOR FOR PIANOS. F. L. Goulvin, Valence, France, 572,981. Filed April 30, 1894.

Adapted to serve as receivers to convey sounds to the ears of persons at a distance from the piano, in the manner of a telephone.

THERMOSTAT. C. Burgher, Newton, Mass., 573,134. Filed Aug. 8, 1896.

The operative parts are protected by a casing arranged to permit of the free circulation of air.

METHOD OF AND MEANS FOR REMOVING PARAFFIN FROM OIL WELLS. F. A. Flanegin, Washington, D. C., 573,142. Filed April 7, 1896.

Consists of a heater provided with a surrounding casing having a contracted upper end and forming a chamber between the heater and the casing in which a paraffin solvent is heated.

PROCESS OF PURIFYING AND DECOLORIZING SACCHARINE OR OTHER LIQUIDS. M. Pridham, Philadelphia, Pa., 573,289. Filed Sept. 10, 1896.

Consists in subjecting the liquid to the direct action of an electric current and simultaneously passing ozone gas through the liquid.

PROCESS OF PURIFYING AND DECOLORIZING SACCHARINE OR OTHER LIQUIDS, 573,290. Filed Sept. 10, 1896.

Similar to above.

APPARATUS FOR PURIFYING AND DECOLORIZING SACCHARINE OR OTHER LIQUIDS. M. Pridham, Philadelphia, Pa., 573,355. Filed Sept. 12, 1896.

Consists of a tank, electrodes, and collecting racks for collecting the impurities precipitated.

SELF WINDING MECHANISM FOR ELECTRIC CLOCKS. C. M. Crook, Elgin, Ill., 573,430. Filed April 20, 1896.

Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. B. E. Osborn, Auburn, N. Y., 573, 033. Filed April 10, 1896.

Sectional conduit system.

ELECTRIC RAILWAY CONSTRUCTION. G. Westinghouse, Pittsburg, Pa., 573,066. Filed June 8, 1896.

A structure for surface contact electric railways, comprising a switch box, a beam provided with contact supporting devices and extending laterally from the switch box beneath both track rails, and means for clamping both the switch box and the beam to the track rails.

SWITCH. E. M. Hewlett, Schenectady, N. Y., 563,146. Filed July 16, 1896.

Magnetic switch for closed conduit electric railways.

ELECTRIC RAILWAY. A. Sprague, San Leandro, Cal., 573,169. Filed March 30, 1896.

Employs a channeled insulated surface rail having a conductor fixed to it with a pivotally secured lever having a trolley to engage the conductor.

ELECTRIC RAILWAY. A. C. O'Connor, Lynn, Mass., 573, 234. Filed Oct. 26, 1895.

Comprises two or more separably variable transmitting mechanisms, each including a motor, together with shifting devices.

TROLLEY POLE SAFETY DEVICE. B. H. Borrenson, Minneapolis, Minn. 573,257. Filed July 26, 1895.

Mechanism for lowering the pole when out of contact with the conductor.

SWITCH FOR ELECTRIC RAILWAYS. S. A. Mustain, Rincon, New Mexico, 573,344. Filed June 22, 1896.

Operated by current from the trolley wire.

STATION INDICATOR FOR RAILWAYS. A. Palfy, Buda-Pesth, Austria-Hungary, 573,350. Filed Aug. 3, 1896.

An electrically operated disc on which the names of the stations are displayed, and an alarm bell to sound when each change has been effected.

Telegraphs:—

MECHANICAL TELEGRAPH-SOUNDER. W. W. Alexander, Kansas Cty, Mo., and M. C. Gilliham, Kansas City, Kansas, 572,945. Filed April 23, 1894.

Operates without a local battery.

RECEIVER FOR SUBMARINE TELEGRAPHS. A. Piedfort, Paris, France, 573,286. Filed Dec. 19, 1895.

Mechanism for tracing on paper the signs corresponding to the direction of the current.

Telephones:—

TALKING MACHINE APPARATUS. E. H. Amet, Waukegan, Ill., 573,071. Filed Sept. 21, 1894.

The talking machine is located at the central station and is heard at substations by means of a controlled telephone circuit.

TELEPHONE CIRCUIT LINE SIGNAL. T. C. Wales, Jr., and C. H. Arnold, Boston, Mass., 573,117. Filed July 20, 1896.

Comprises a call signal, a signaling current generator furnishing current therefor, a secondary line signal in a local circuit, and a polarized electromagnetic device in inductive relation with the circuit of the generator controlling the secondary signal.

TELEPHONE TRANSMITTER. F. A. Ray, Boston, Mass., 573,294. Filed April 6, 1896.

Comprises a diaphragm consisting of two members, a fixed member, a vibrating disc contiguous to the fixed member, and a plurality of flexible supports which interconnect the two members.

TELEPHONE TRANSMITTER. L. W. Pullen, Camden, N. J., 573,356. Filed Nov. 11, 1895.

Consists of two or more opposing electrodes yieldingly connected together in such a manner as to form a cavity or chamber between them, and an insulating ring extending into the chamber between the electrodes.

Trade Notes and Novelties

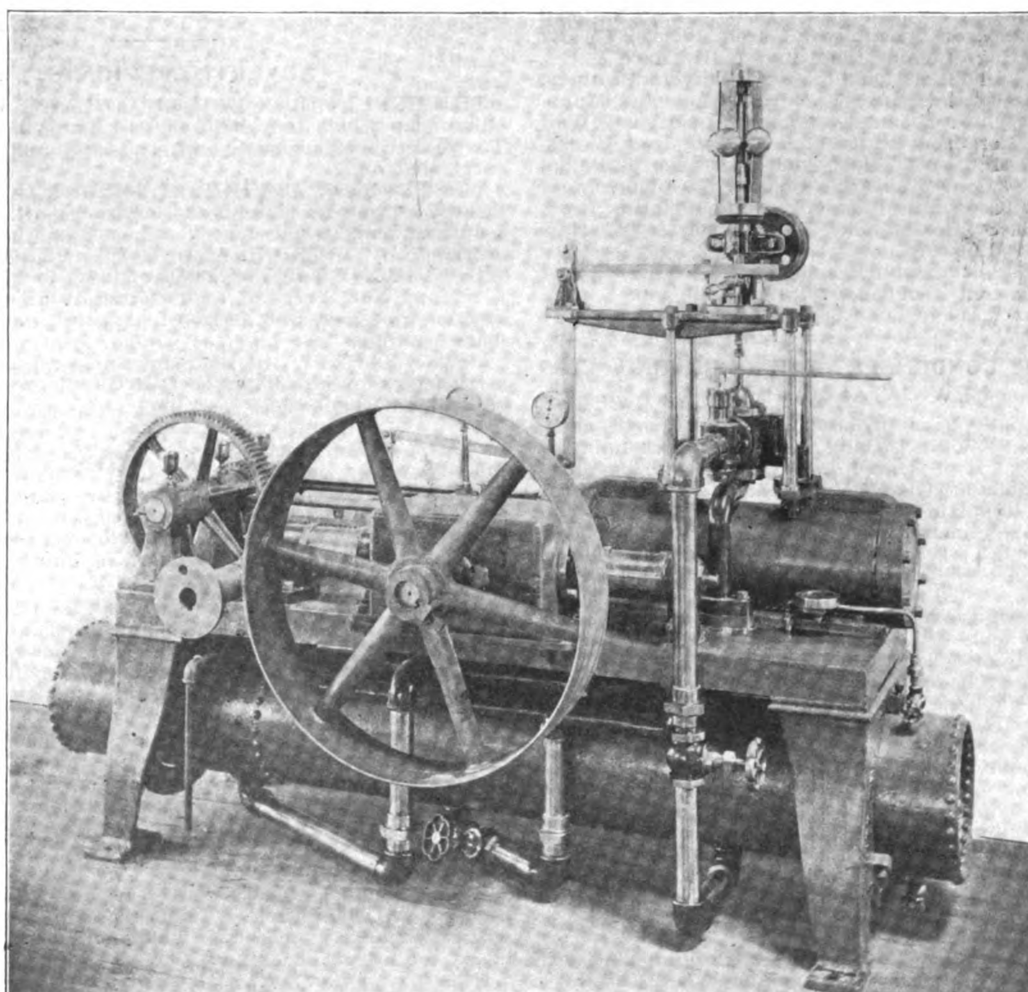
AND MECHANICAL DEPARTMENT.

LOMBARD WATER WHEEL GOVERNORS.

The regulation of water wheels driving electric generators has always been a serious problem with which hydraulic engineers have had to contend, but it would seem that regulation can now be had comparable with that obtained with the automatic steam engine.

This close regulation has been accomplished in the Lombard water wheel governor which was selected and installed in the magnificent, up-to-date power house of the Bridge Mill Power Company, at Pawtucket, R. I., which is illustrated elsewhere in this issue. The Lombard Water Wheel Governor Company, of 61 Hampshire street (Roxbury), Boston, Mass., claim that since they have been in business they have never failed to govern water wheels operating electric street railway generators (the most difficult load to govern), to the entire satisfaction of the purchaser. The company's governors are now being used successfully with every modern make of turbine, working under heads varying from 6 to 200 feet.

The accompanying engraving represents the type C, Lombard water wheel governor installed in the Bridge Mill plant.



LOMBARD WATER WHEEL GOVERNOR, TYPE C, BRIDGE MILL POWER PLANT.

RODNEY HUNT TURBINES AND LOMBARD GOVERNORS.

The Rodney Hunt Machine Company, of 70 Kilby street, Boston, are installing a plant, consisting of eight pair of wheels similar to those now running in the Bridge Mill Power plant at Pawtucket, R. I., described elsewhere in this issue. These wheels will be placed in the plant of the Columbia Water Company, at Columbia, S. C., and will develop 11,000 horse power. As in the case of the Pawtucket plant, the wheels will be equipped with Lombard governors, manufactured by the Lombard Water Wheel Governor Company, of 61 Hampshire street (Roxbury) ,Boston, Mass.

PHILLIPS' INSULATED WIRE.

We have received from the Phillips Insulated Wire Co., of Pawtucket, R. I., the new price list and samples of their fire and weather-proof wire, underwriter's wire and "Ideal" wire, all of which they are making in connection with their celebrated "O. K." weather-proof wire. The Ideal wire is specially worthy among this class of conductors. It has a black insulation with white fireproof outside finish, adapted for exposed wiring when a good white finish is desired. The prices also are very attractive and with the probable early to be looked for rise in copper, intending purchasers would do well to communicate promptly with the Phillips Company.

TORRINGTON, CONN.—The Hendey Machine Company have adopted the Eddy system for lighting and power transmission in their new shop.

THE PURITAN ELECTRIC CO.

The inclosed arc lamp has made wonderful strides during the last two years, but thus far it has been used only in connection with direct current circuits. When one considers the large preponderance of alternating current stations in the United States, it must be evident that a still greater usefulness awaits the enclosed arc lamp on alternating circuits. To meet this demand the recently organized Puritan Electric Company, of 150 Nassau street, New York, and 178 Devonshire street, Boston, Mass., have brought out an alternating enclosed arc lamp, possessing a number of striking features. Thus, the lamp will burn equally well on circuits of 7,200 or 16,000 alternations, while at the same time it can be run on continuous current circuits without change of adjustment. The burning of the lamp is very steady, and the feed is imperceptible. The lamp is also practically inaudible in operation. The lamp is 33 inches long and burns 10 hours. Mr. Stuart W. Wise, formerly with the Manhattan General Construction Company, is the president and general manager of the company.

KENT'S LUBRICATING COMPOUND.

This compound, which has come into successful use, is constantly increasing in popularity. Owing to its peculiar composition it adheres to the bearing surface, where it is needed, instead of flowing away from it. Every particle of it is a lubricant, but the mixture is so happily chosen that they blend perfectly to form a homogenous and stable compound.

Among the hundreds of users of Kent's compound we may mention the following: Consolidated Gas Company, National Saw Company, Jackson Architectural Iron Works, De La Vergne Refrigerating Machine Company, L. H. Mace & Co., Interior Conduit and Insulation Company, Travers Brothers, Louis Bossert, Bronx Company, T. New Roofing and Manufacturing Company, F. E. James Company, National Wall Paper Company, Ferguson Brothers, J. L. Mott Iron Works, Edwards & Co., Methodist Book Concern, Judge Building, Quintard Iron Works, George Fox's Sons, J. E. Linde Paper Company, Central Cooperage Company, Potter Printing Press Company, Hudson Steam Laundry, Baumgarten & Co., Harper Brothers.

Kent's lubricating compound is sold by the New York and New Jersey Lubricant Company, 30 Cortlandt street, New York.

THE WHEELER CONDENSER & ENGINEERING CO'S NEW CATALOGUE.

The above company have just issued a very artistic catalogue of the Barnard Water Cooling Tower, of which they are the manufacturers. It is printed on heavy calendered paper, well illustrated and describes the system in its application and adaptability to steam and refrigerating plants.

Of late years the constructing engineer has been afforded opportunity to install the most improved appliances with continued gain of economy. Condensing apparatus, where water is available for it, is now regarded a necessity, in so much as to often cause the location of a plant at a remote point to meet this end. It is under just such conditions that the Barnard system demonstrates its value as by it any engine or unit of power may be operated, condensing with a high degree of vacuum. The purified distilled water is very desirable for boiler feed supply, as no scale is formed in the boilers and the consequent loss in fuel and labor is eliminated. In cities, where the yard room for the cooling tower cannot be had, the roof of the building or other elevation may be utilized.

The Wheeler Company make a specialty of surface condensers, heaters, filters and evaporators, publishing separate catalogues of them, which may be obtained by addressing them at their new offices, 120-122 Liberty street, New York.

METROPOLITAN ELECTRIC CO.

The catalogue of the Metropolitan Electric Company, of Chicago, contains 755 large-sized pages, and over 2,250 illustrations, covering practically everything in the electric line, with a large amount of information on the various articles illustrated. In fact, the catalogue is, in reality, an encyclopædia of electricity, and is used very largely for reference by engineers, electricians, colleges and institutions where electricity is studied. The book is handsomely gotten up, well bound and printed on fine paper, and is a valuable addition to any collection of books on electricity, as well as to the reference books necessary to any purchasing agent.

J. B. COLT & CO., 115 Nassau street, New York, have removed their St. Louis office to 517 Olive street.

NEW MANAGER FOR THE C. & C. ELECTRIC CO.

The C. & C. Electric Company have appointed Mr. D. W. Barnes as general manager of their business, with headquarters in their general offices, at 143 Liberty street, New York. Mr. Barnes has been associated with the C. & C. Company since 1890, having for the past year filled the position of chief engineer in entire charge of the company's works at Garwood, N. J. Previous to that time he had charge of the mechanical design at the works. Mr. Barnes thus brings with him to the management of the company's affairs a thorough and practical knowledge of all branches of the business. He is thoroughly versed in the matter of successful manufacturing, as well as engineering, and intends to push the company's business, especially in the field of electric power and isolated plants.

A BIG ST. LOUIS ELECTRIC COMPANY.

The St. Louis Electric and Construction Company has filed articles of incorporation. It has a fully paid capital stock of $600,000. The incorporators holding one share each are as follows: Ellis Wainwright, Charles H. Turner, Geo. J. Kobusch, Philip Stock, L. B. Pierce, Rolla Wells, Breckinridge Jones, Julius J. Walsh, Adolphus Busch, C. K. D. Walsh, Wm. T. Haarstich, Otto Von Echrader, C. Marquard Foster, Henry Nicholas, August Gehner, Hopkins H. Crawford, Wm. C. Orthwein, Wm. F. Walker and H. S. Priest. The remaining shares, 5,980, are held by James H. Parish. The company proposes to do a business both in electric lighting and in telephony.

ADVERTISERS' HINTS.

THE BERLIN IRON BRIDGE COMPANY illustrate a machine shop which they built for the Titusville (Pa.) Iron Co. The roof trusses are made entirely of iron and are designed to carry shafting.

WESTINGHOUSE, CHURCH, KERR & CO. have recently installed the steam plant of the Pawtucket (R. I.) Electric Co., a description of which may be found on another page.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY will take the opportunity to wish their friends a "Happy New Year" at their Cortlandt street offices on the afternoon of Dec. 31st. Drop in and see them—you will be made welcome.

HEINE SAFETY BOILERS for the steam generating plant at the works of the Pawtucket (R. I.) Electric Company, are described in this issue.

NEW YORK NOTES.

A POCKET CALENDAR printed on celluloid and covering the entire year of 1897, is furnished by the Fuel Economizer Co., of Matteawan, N. Y. It is a very convenient thing and for real usefulness is not surpassed by anything we have yet seen for next year.

THE ELECTRIC PROTECTION CO., of Philadelphia, have issued a notice to the trade of important changes in quotations of their Stevens flush switches. They also state that hereafter Mr. C. D. Shain will be their sales agent for the States of New York, Connecticut and New Jersey north of Trenton.

FRED M. LOCKE, Victor, N. Y., in furnishing his high-grade triple petticoat insulators, made them of Imperial porcelain, which stood the severe test for the Niagara Falls-Buffalo transmission line, to which they were subjected. The insulators stood the test nobly, where other grades of porcelain had failed.

THE GARVIN MACHINE COMPANY, New York, have issued a pocket map of New York City and vicinity within a radius of 16 miles, and a detailed map of New York City on the reverse. The whole is inclosed in a pasteboard cover, with a space for memoranda, which contains a little advertising of the Garvin machinery.

JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., have just issued a neat little pamphlet, prettily covered, illustrative of their various graphite productions for use in a wonderfully wide range of industries. All their manufactures are standard and popular, and are set forth in this book with surprising fullness of illustration and detail.

NIAGARA-BUFFALO.—Reports from Niagara go to show that the power transmission to Buffalo is working very successfully. The trouble with the insulators has been eliminated since the exclusive use on the line of the "Niagara" insulators made by the Imperial Porcelain works of Trenton, N. J., to which descriptive references have already been made in our pages.

ACTIVITY OF THE AMERICAN ENGINE CO.

We have received from the American Engine Company, Bound Brook, N. J., the following list of their apparatus supplied during November: 18 kilowatt dynamo, Syracuse "Post," Syracuse, N. Y.; 50 kilowatt dynamo, "Evening Star," Washington, D. C.; 25 horse-power motor, Springfield "Union," Springfield, Mass.; 12 horse-power motor, New York "Tribune;" 12 horse-power motor, Peoria "Herald," Peoria, Ill.; 12 horse-power motor, Duluth "News Tribune;" 1 8x8 inch engine, Leavenworth "Times," Leavenworth, Kan.; 5 horse-power motor, St. Paul "Pioneer Press;" 10x10 inch engine and 50 horse-power boiler, Chinese Government; 25 kilowatt dynamo, the "Morning News," Savannah, Ga.; 5 horse-power motor, Salem "Daily Gazette," Salem, Mass.; 12 horse-power motor, Chicago "Journal;" 50 horse-power motor, Boston "Daily Post;" 75 kilowatt dynamo, Kansas City "Star;" 12 horse-power motor, W. D. Boyce & Co., Chicago, Ill.; 14x12 inch engine, J. Harper Bonnell Co., Long Island City, L. I.

NEW YORK NOTES.

SUBMARINE CABLE making and laying will be the subject of a special article in McClure's Magazine for January. It will be illustrated.

T. J. MURPHY & CO., the manufacturers of electrical supplies, have made an assignment to F. Hulse, with a preference of $1,597 to the Eureka Tempered Copper Co. The total liabilities are $7,000.

KENSINGTON ENGINE WORKS.—We are informed that the Kensington Engine Works, Ltd., whose main office and works are at Philadelphia, Pa., have opened a branch office at 74 Cortlandt street, New York City.

C. F. CROSELMIRE & SON, 251-255 New Jersey Railroad avenue, Newark, N. J., are large manufacturers of platinum wire, the raw stock of which they import direct from Russian mines and refine at their works. Their business was established in 1875 and is known throughtout the electrical and other fields.

DALE MANUFACTURING COMPANY, Greenwich street, New York City, report that they are very busy on their various lines of trade, and that the outlook for the new year is excellent. They will be glad to entertain inquiries for electrical specialties of all kinds, particularly those to which they devote attention.

THE GARVIN MACHINE COMPANY, Spring and Varick streets, New York City, have a splendid new building run by electric power and are turning out some fine goods. Their new little brochure of bicycle machinery is a revelation as to the special tools they make for that line of trade, and shows much ingenuity and large resources.

A. O. SCHOONMAKER.—In order to meet the increasing demand from his Western trade, A. O. Schoonmaker, of 158 William street, has opened an office at 1563 Monadnock Building, Chicago, where he will be represented by Mr. John Child, who will carry a full line of his well-known India and amber mica and be prepared to fill all orders promptly.

BACKUS WATER MOTOR COMPANY, 174 Pennsylvania avenue, Newark, report business good and prospects very bright for the sale of their gas engines. They recently installed a 20 horse-power gas engine for driving an electric plant in Pittsburg, in which city they also obtained an order from Bair & Gazzam Company for two 20 horse-power and one 12 horse-power engine.

THE WILSON & WINKLER CO., 779 Greenwich street, New York, have just completed a large wiring contract for the Claus Lipsius Brewery, Brooklyn. Both Messrs. Wilson & Winkler are practical men, having had thorough experience for many years in the works of the General Electric Co., Schenectady. This firm build and refill commutators, do general construction and switchboard work, and deal also in engine and dynamo supplies.

THE LINK BELT ENGINEERING COMPANY, of Nicetown, Philadelphia, and 49 Dey street, have issued a most valuable and interesting book of 130 pages devoted to modern methods in elevating and conveying materials and in the transmission of power. There are many points of value to electric lighting and street railway men, and copies of the book will be gladly sent to them by the enterprising publishers, on application.

MR. M. R. RODRIGUES, of 19 Whipple street, Brooklyn, N. Y., reports that in one day's mail recently he received orders for fifty medical batteries and 250 of his celebrated "Baby" motors. Among the new apparatus he is placing on the market is a small medical battery 6½x3¼ of great strength, which will retail at a low price. This battery has been tested, and has given excellent results, the strength of the current being something almost phenomenal. The factory is working late nights to keep up with the orders already on hand.

THE GLENS FALLS PAPER MILLS COMPANY, of Glens Falls, N. Y., are making extensive improvements in their various plants and have placed an order with the Berlin Iron Bridge Company, of East Berlin, Conn., for a new pulp mill, at Cadyville, N. Y., including water tower and boiler house. They have also placed an order with the Berlin Iron Bridge Company for additional buildings for their Kent's Falls plant, consisting of a pulp mill, boiler house, barker room, and wood room. The contract is a large one. Orders for machinery for equipping the various buildings will be placed at once.

THORPE, PLATT & CO., Fidelity Building, Cedar street, New York, are placing on the market the Geipel patent steam trap, which will be sent on approval. It is said to have met with extraordinary success in Europe and is used by the British Admiralty for high pressure steam as well as in public buildings, where heating with exhaust steam is employed. The form in which the expansion parts are arranged, viz., that of an isosceles triangle, causes a large motion to be imparted to the apex for very small changes in the length of these parts. It will work on widest variations of pressure and will discharge against a head.

THE IMPERIAL ELECTRIC COMPANY, 140 Washington street, New York, report their factory very busy on a large variety of work. This company manufactures electrical specialties of every description for outside firms under contract. Their excellently equipped factory is under the personal supervision of thoroughly experienced and practical men. Mr. J. W. Eskholme is vice-president and general manager, and Mr. H. J. Linder, secretary and treasurer. The Imperial Electric Company manufacture slow-speed dynamos and motors, electrical and hardware sundries, aside from which they do experimental work, designing and repairs.

WESTERN NOTES.

CICERO, ILL., was to have had incandescents for street lighting, but the committee has now decided to reject all such bids and to advertise only for arc lights.

THE MICHIGAN PIPE COMPANY have, we regret to learn, suffered severely from a fire at their plant, Bay City, Mich. The loss is put at about $100,000; the insurance is $35,000.

PRESIDENT J. E. KEELYN, of the Western Telephone Construction Company, has been in the South planning for an extensive system of independent service, running from Norfolk, Va., across to Cincinnati.

The CONNECTICUT TELEPHONE AND ELECTRIC CO., Meriden, Conn., have issued a very pretty and tasteful calendar illustrative of the idea that beauty when unadorned looks best. It will attract attention wherever hung.

CEDAR RAPIDS, IOWA.—The "Independent" Telephone Company has already reached its limit of 500 subscribers, and has had to put in another section for 100 additional numbers, in its exchange. It has also ordered 5,000 feet of cable. The apparatus of the American Electric Telephone Company, of Kokomo, Ind., is used.

THE ELECTRICAL APPLIANCE CO. report that their Armorite interior conduit is meeting with a rapid sale. The great advantage in being able to bend the conduit, and thus avoid the use of regular and special elbows, is very much appreciated by the trade. The saving in time required for installing is also a point that is not overlooked.

H.-S.-G., standing for "Honest-Standard-Gold," also stands for the trade-mark of Houston, Stanwood & Gamble, engine builders of Cincinnati, O. A golden yellow card just issued by that firm tells the reader that he can know more about high grade substantial steam engines by addressing the firm and asking for the latest edition of their Ready Reference Book.

GREELEY, COLO.—At a meeting of the City Council, held Dec. 15, the Committee on Electric Lighting was instructed to look up the matter of placing a lighting plant, to be run in connection with the city water plant, so that the city can supply itself with its own street illumination. Mr. D. F. Camp, City Marshal, can be addressed. Mr. M. F. Henderson is superintendent of the city water-works.

THE CAMP CLAYPIPE CONDUIT made by the H. B. Camp & Company, of Greentown, O., is a favorite with electrical companies, as shown by its frequent use. Last month we mentioned the employment of Camp conduit on the Niagara-Buffalo transmission. The Central Union Telephone Company have laid this conduit in Toledo and Columbus, O., this year, and will use about 50 miles at Indianapolis.

MINNEAPOLIS, MINN.—The St. Anthony Water Power Company have closed a contract for fourteen pairs of horizontal water wheels to be used in the power house at the new dam. The Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, was the successful bidder. These water wheels are to be 42 inches in diameter, with cylinder gates, and, in connection with the dynamos, will be expected to develop a minimum of 9,000 horse power.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Kokomo, Ind., reports satisfactory business, notwithstanding the lateness of the season. The following contracts have recently been filled: Crown Point, Ind., exchange outfit for 150 telephones; North Manchester, Ind., 100 telephones; Georgetown, Ky., 100 telephones; Montpelier, Ind., 100 phones, besides an order for a full telephone equipment for Fort Crook, Neb. This latter order comes from the War Department.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., have just issued a very handsome quarto catalogue of 208 pages, beautifully illustrated and in two or three colors of ink, devoted to their apparatus for heating, ventilating and drying. Aside from its attractive appearance and arrangement, the book is of a high order of merit and its contents embody data that is of the utmost value to engineers, contractors and architects. The problems of ventilation are dealt wtih very thoroughly.

THE AMERICAN BATTERY CO., 40 West Quincy street, Chicago, recently closed a large order for storage batteries with the Pullman Palace Car Company. This order which will amount to several thousand dollars, goes to show that the future outlook for a speedy revival of trade is good. The American Battery Co., have also been the recipients of several other smaller orders, and report that they have as much as they will be able to attend to for more than a month to come.

THE ELWELL-PARKER ELECTRIC COMPANY, OF AMERICA, whose factory and headquarters are in Cleveland, with branch in the Havemeyer building, this city, W. A. Stadelman, manager, announce themselves as ready to build generators and motors from 1 horse-power up to 1,200 horse-power, as well as special power apparatus. They have already turned out some admirable electrical machinery, and their apparatus is destined to enjoy large and growing favor. The company invite inquiries and correspondence.

LUNDELL MOTORS WEST.—The Western Electric Company, of Chicago, has been given an agency for the complete line of Lundell power motors, which range in size from one-sixteenth of a horse power up to any size required. These motors are completely encased, and are generally regarded among the trade to be one of the best motors on the market. They can be readily connected to printing presses, ventilating fans, and are also used for blowing large organs, and wherever electric power is desired these motors are especially applicable. These motors will be kept in stock in Chicago subject to immediate delivery, and prices and full information will be given upon application.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, has opened a branch office in room 507 Security Building, St. Louis, with Mr. F. C. Cosby in charge. Mr. Cosby previously held the position of assistant to Mr. J. R. Wiley, manager of the Chicago office of the company, and is well suited for his new duties, in which he has the best wishes of his many friends. Mr. Wiley reports that the business of this enterprising concern is still very brisk, and that there are good prospects for a still further increase in the near future. Mr. Wiley has just returned from a trip to St. Louis, and he is keeping his weather eye open in expectation of making some good deals in the Mound City before very long.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., reports still another addition to its force of instructors. Mr. I. H. Sherwood, a graduate of Case School of Applied Science has been employed by the firm of E. P. Roberts & Co., and will also assist as instructor in the Correspondence. Mr. Sherwood worked as a machinist before going to college, and as a machinist and engineer during the time he was at college, and is now a licensed stationary engineer. Mr. Sherwood's experience is such as makes him able to thoroughly appreciate not only the value of an education, but the difficulties and trials met by those who have to obtain same by their own efforts. Mr. Sherwood is also assistant instructor in electrical engineering in the Y. M. C. A. course in Cleveland.

ELECTRIC APPLIANCE COMPANY.—The degree of success attained with enclosed arc lamps is largely dependent on the carbon used and it has been a difficult matter to find a carbon exactly suited to that work. Manufacturers of enclosed arc lamps are, however, rapidly coming to the conclusion that the "Electra" high-grade "Nuernberg" carbon is the proper one to use and the majority of such manufacturers are recommending and urging the use of "Electra" carbons with their lamps. So great has been the demand for "Electra" carbons for enclosed arc lamps that it has been impossible during the past few months to import them fast enough. The Electric Appliance Company report a splendid business in these goods, and state that all of their customers are more than pleased with them.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, are still retaining their record of constantly keeping busy. They are at present building ten exchanges complete, to be installed in various parts of the United States. They are placing their own engine, and will generate their own power. They claim to be the only telephone manufacturers who make every part of their own instrument upon the premises, inclusive of their woodwork. This company have now in press their new catalogue, which will be one of the most complete on the market, and they will be pleased to send one upon application. They also have issued 10,000 copies of one of the handsomest calendars ever given away gratis. They solicit correspondence on anything pertaining to telephones, toll lines, or private lines, and manufacture the most complete line of telephones upon the market. They make 12 styles of microphones, 25 styles of instruments and 4 styles of switchboards.

MR. E. W. HAMMER, informs us that he has disposed of his controlling interest in the Cutler-Hammer Manufacturing Company, Chicago, and will sever his connection with that concern on January 1, 1897. Mr. Hammer states that it is his intention to take a long and much needed rest, and that he will afterwards re-embark in the same line of the electrical business that he is engaged in at present. Mr. Hammer states that he will always take a lively interest in the welfare of his old concern, with which he has been connected since its birth, and notwithstanding that since the starting of the business it had to contend against unusually bad times, its rapid growth to its present prosperous condition goes to show how much may be achieved by indomitable energy, and strict business integrity, and Messrs. Cutler and Hammer are to be congratulated on their success in the face of the severe obstacles with which they had to contend. When Mr. Hammer returns to the electrical business we trust he will have the same prosperity with which his former efforts were rewarded.

NEW ENGLAND NOTES.

HYDE PARK, MASS.—The Hyde Park Street Railway Company are erecting a new power station. The boiler room is 44 feet wide and 87 feet long, and the engine room is 56 feet wide and 115 feet long. The building is to have brick walls, and the roof is to be supported by steel trusses. The steel work has been designed and will be furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn. gree of vacuum. The purified for boiler feed supply asrdji

THE POPE MANUFACTURING COMPANY, Hartsford, Conn., have brought out for 1897 the twelfth annual issue of their excellent Columbia desk calendar. It is far more than a daily reminder of the glories of the Columbia wheel. It is neat, useful, tasteful, with special little touches of convenience and handiness, suggestive, like all Columbia things, of the highest economy of time and space.

THE RHODE ISLAND TOOL COMPANY, of Providence, R. I., have placed the contract for their new galvanizing room with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be a fireproof structure throughout, no woodwork being used.

THE AMERICAN ELECTRIC HEATING CORPORATION say: "The small 4½ in. stove recently put on the market by the American Electric Heating Corporation, of Boston and Chicago, proves to be even more popular than was anticipated and not only is it being largely used in the household, but it fills one of those 'long felt wants' or 'aching voids.'"

THE MOSSBERG AND GRANVILLE MANUFACTURING COMPANY, 101 Sabin street, Providence, R. I., whose removal from Attleboro, Mass., has just been completed, occupy in their new quarters more than two acres of floor space, and are there operating a most complete modern shop. On the first floor are the stock room, heavy machinery, radial drills and large steam hammer. On the second floor are the lathes, milling machines and large grinding shop, tool rooms and test-rooms. On the third floor are the draughting room, pattern shop, photographic department and storerooms. A private elevator connects all floors. The offices, which occupy the entire front of this floor, are finished in sheet steel and oak, and are most complete in every detail. Among their specialties may be mentioned a press, which punches armature sheets complete at one operation.

THE WENSTROM ELECTRIC CO. stockholders held their annual meeting last week at Baltimore. The vote for directors to serve during the ensuing year resulted in the choice of Messrs. Gaun M. Hutton, F. C. Latrobe, Robert Rennert, H. Marcus Denison, Peter E. Tome, Seymour Mandelbaum and James A. Gary. Mr. Gary was chosen in place of Mr. J. M. Denison. Mr. Rennert entertained those present at luncheon at the Hotel Rennert.

Department News Items will be found in advertising pages.

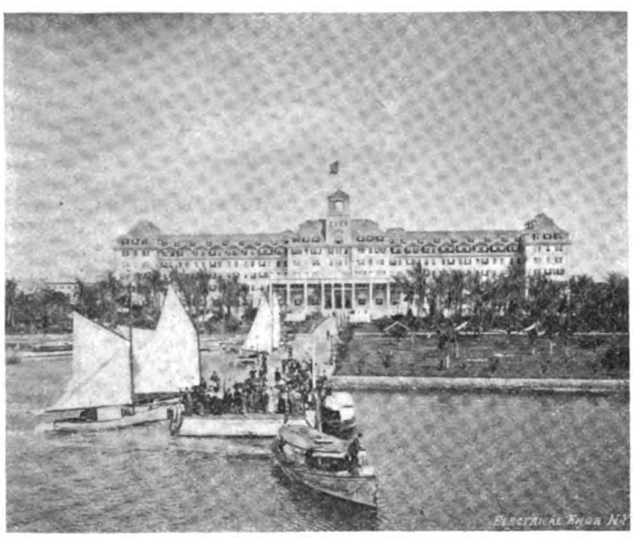
THE
Electrical Engineer.

Vol. XXII. DECEMBER 30, 1896. No. 452.

ELECTRIC LIGHTING.

ELECTRIC LIGHTING OF THE ROYAL POINCIANA HOTEL AT PALM BEACH, FLORIDA.

THE rigor of our Northern climate annually compels many thousands to seek more agreeable climates, and year after year Florida has been gaining in popularity as a winter



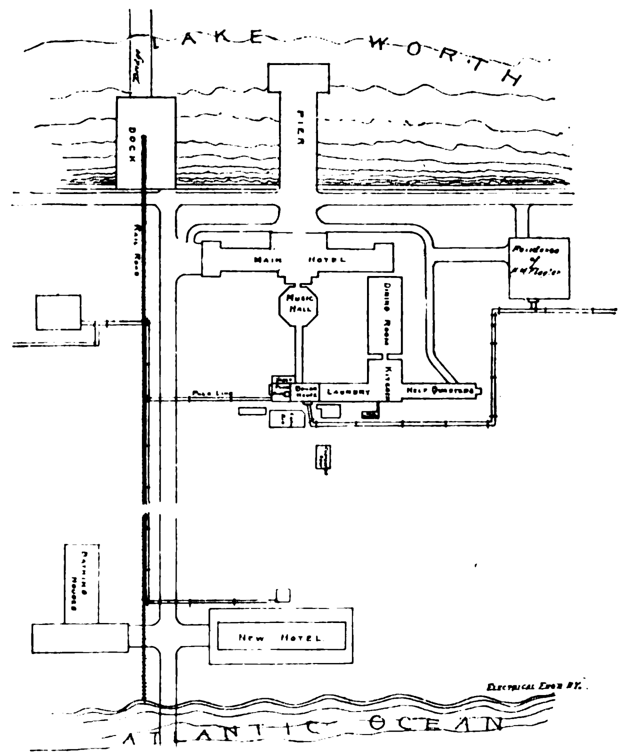
THE ROYAL POINCIANA HOTEL, PALM BEACH, FLORIDA.

resort. Mr. Henry M. Flagler, whose energy and enterprise has already created many beautiful resorts in that enchanting region, has recently added another, which has already secured

POWER HOUSE WITH CONVERTERS AT THE ROYAL POINCIANA.

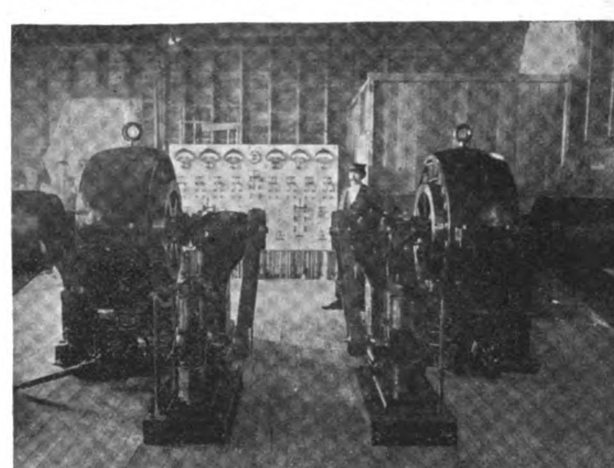
for itself an enviable reputation for the beauty of its surroundings and the elegance and completeness of its equipment.

This new resort, Palm Beach, with the Royal Poinciana, is situated on the east coast of Florida. The main hotel faces Lake Worth, as shown in the accompanying map. It is 600 feet long, with wings, running at right angles, whose capacity is double that of the main building. This lake is situated



PLAN OF HOTELS AND SURROUNDINGS, PALM BEACH, FLORIDA.

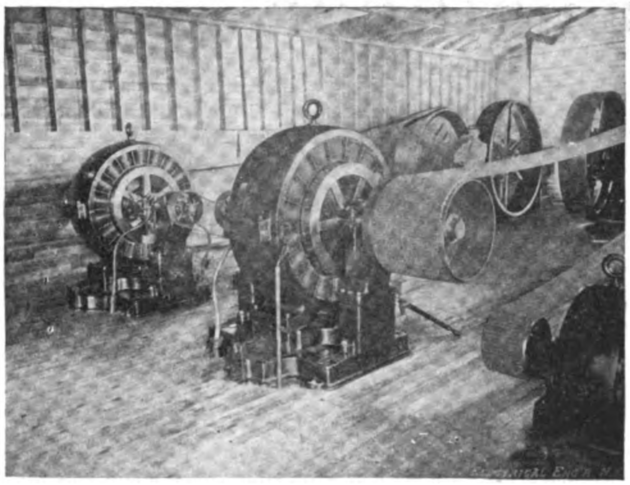
about 3,000 feet from the shores of the ocean, and is connected with the latter by a beautiful road shaded by palms on both sides. At the ocean terminus of this road another hotel, known as the Palm Beach Inn, has been erected, for those



VIEW IN DYNAMO ROOM, ROYAL POINCIANA.

who prefer direct ocean breezes and greater proximity to the sea.

Following Mr. Flagler's previous work in this direction no other illumination but that by electricity was at all considered. The electric lighting plant installed presents a number of novel features and was laid out so as to afford current for both hotels. For this purpose a power house was erected in the rear of the Royal Poinciana, with a capacity for 9,000 lights. The

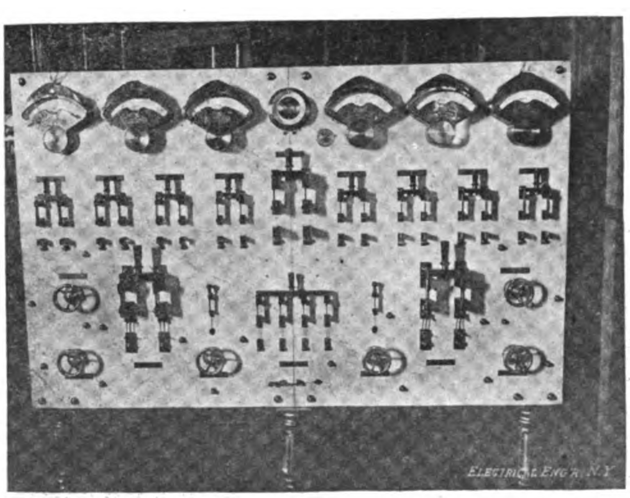


La Roche Alternators, The Royal Poinciana.

current is generated by three La Roche 150 kilowatt alternators and one 25 kilowatt alternator, two views of the dynamo room being shown in the accompanying illustrations. These dynamos are belted to three tandem compound non-condensing Ideal engines, built by the Harrisburg Foundry and Machine Co.

The alternators are wound for 300 volts and the circuits at this potential run directly into the hotel through underground ducts of the Interior Conduit and Insulation type, and up the elevator shafts at the same potential, 300 volts. On every floor close beside the elevator shafts there are placed panel closets, as shown in the accompanying engraving, each closet containing a distributing board in which is mounted a step-down transformer, which lowers the potential from 300 to 112 volts, which is the working voltage.

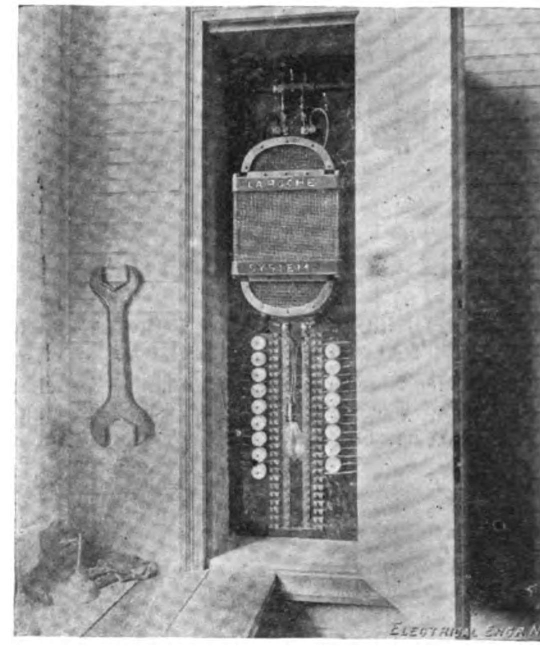
The switchboard employed at the power house is designed on an original plan, and is so arranged as to provide for the



Switchboard in Lighting Plant, Royal Poinciana.

varying amounts of lights used in the hotel at different times, so as to connect the machines in the most economical way, as the load changes. The switchboard contains two main switches and a relay switch. The latter connects the three bus-bars in multiple, which are then fed by a small engine and dynamo, which carries the day load of all circuits.

The alternating generators are operated in parallel, a method which has made very little, if any, progress in this country, although we are told that it is frequently done abroad. The manner in which the running in parallel is carried out is quite simple and is worthy of notice. The two engines carry the main night load. The governor is removed from one of these engines. In starting up, the governing engine is first given steam and brought up to full working speed, and its dynamo

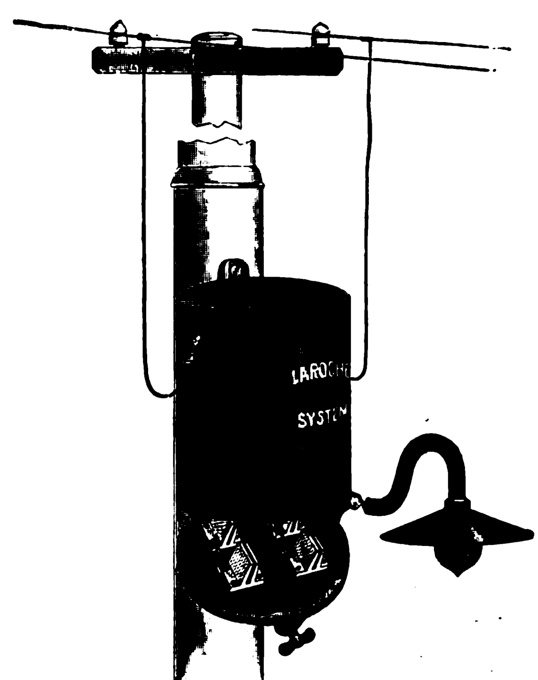


Floor Panel Closet in the Royal Poinciana.

switched into the circuit. The engine without a governor is then started and when up to speed the alternator immediately falls into step, and the governing of both engines is accomplished by the single governor, the second alternator governing its own engine and being kept in speed by its mate. No difficulty of any kind has been experienced with this method.

The three boilers are of 600 horse-power, total capacity, of the Gary water tube type.

For supplying current to the Palm Beach Inn about a mile



La Roche Converter for Pole Lights.

distant, the 300 volts primary current generated by the dynamos is led into four 30 kilowatt step-up transformers mounted on supports in front of the power house, as shown in the accompanying engraving. The transformers raise the potential to 1,000 volts, at which it is carried to the Palm Beach Inn.

There it enters the step-down transformers placed in a special transformer house erected for that purpose, and the current is reduced to 112 volts and fed directly to the lighting circuits through panel closets in the same manner as at the Poinciana.

The road leading to Palm Beach is illuminated at night by

PALM BEACH ROAD, PALM BEACH, FLORIDA.

one hundred 50 candle-power lamps placed under reflectors, after the manner shown in the accompanying engraving. These lamps are fed by the small converters shown, which are mounted on poles, the majority of them having arms extending out above the middle of the road. The converters, as will be seen, have the switch contacts mounted on a cover which opens downward. Thus by loosening a screw or a spring catch, and throwing the cover down, the circuit is completely broken and the converter can be handled and fuses renewed without danger to the attendant.

In addition to furnishing current for the Palm Beach Inn, the power house at the Poinciana has three additional large step-up transformers which raise the potential from 300 volts to 2,000 volts, at which it is carried to a point four miles off at South Palm Beach, and also to various private residences at North Beach, a few miles to the north.

The entire system of lighting above described was designed by Mr. F. A. La Roche, of the Ideal Electric Co., who also built the entire apparatus. The installation has been admirably carried out by Mr. A. V. Best, engineer and electrician. Mr. Best has charge of all of the electrical work of Mr. Henry

A. V. BEST.

M. Flagler, and it was he who remodeled the electrical work of the Hotel Ponce de Leon and Alcazar at St. Augustine.

BRAMBEL'S "ARCODESCENT SYSTEM."

Mr. Grant Brambel, of Sleepy Eye, Minn., is bringing out a new system, which seems a little behind the times: "This system of lighting consists of a dynamo, and commutator, from which may be drawn current for arc or incandescent light at pleasure of the consumer also a new pattern lamp for arc lighting and a new design of incandescent lamps. At present where consumers desire both arc and incandescent lights it is necessary to purchase two dynamos and wire for the two different currents, or to use what is called the series system, a very expensive and dangerous application of electricity. By using the Brambel System but one dynamo is used and one system of wiring. It is a very easily understood and very easily operated machine and the lamps used are much less expensive and easier to handle and care for than the arc light now commonly used. The Brambel System of electric lighting is certainly an economical system both to operate and to install."

ELECTRICITY IN CHRISTMAS STORE DECORATION.

IT is said by those who have made the round of the great retail stores this year that the resort to electricity for purposes of decoration, dazzlement and bewilderment has been on a larger scale than ever. Perhaps this is due in New York City to the entrance of the two new vigorous competitors into the lists for public favor; so that while the newer concerns

CHRISTMAS TREE AND OTHER LIGHTING EFFECTS, "BIG STORE," NEW YORK.

have tried to fill the public eye with visions of beauty in their stores, the old houses have resolved not to be outdone or cast into the shade. It seems positively unfair to pick out or point out any store, where all have done so much and employed the electric light so liberally; but it must be said that Siegel-Cooper's "Big Store," to which we have already drawn attention, was by far the largest user of electricity for Christmastide spectacle.

The main stairway was lavishly trimmed with verdant festoons and suspended above the balustrades were 60 Japanese lanterns, each containing one 16 candle-power Imperial lamp. On the second floor over the fountain and statue of The Republic (which was not in operation, owing to its basin being used for trade purposes), was a Christmas tree about 15 feet high, on which were strung 300 8 candle-power Imperial lamps (frosted and plain) in series of 3 and 8.

At the rear of the second floor was a cottage covered with snow in which sat a man dressed to represent Santa Claus. The interior was lighted electrically.

The window on 19th street and Sixth avenue contained toys of every description, shown on a moving platform operated by a chain and sprocket arrangement driven by a ½ horsepower Eddy motor, and lighted by 100 16 candle-power Imperial (frosted and plain) lamps. Next in order (on the Sixth avenue side) was a window containing a goodly display of grouped handkerchiefs. Every few moments the bottom gradually moved away disclosing a beautiful tinsel and color effect; then the pyramids of handkerchiefs one by one disappeared and their places were occupied by miniature fairies.

The next move carried the "back drop" skyward and revealed an elaborate floral scheme and finally the wings revolved transforming the whole arrangement into a fairy grove. In the "back drop" was a circular aperture 5 feet in diameter behind which, when the transformation was complete, was disclosed Santa Claus in a house, in the act of filling the stockings near the chimney. This effect was produced by having a piece of gauze covering the aperture, opaque when first seen, but becoming transparent when 12 32 candle-power Imperial lamps were turned on. These being frosted cast a glow over the whole. There were also in this window 75 16-candle-power Imperial frosted lamps concealed behind the "wings," among the "borders" and underneath the fairies.

In the window on the right side of the main entrance was a monster spider's web. In one side of the web was a spider whose eyes containing 4 candle-power Imperial lamps were blinked automatically by the aid of a commutator (built by the electrician of the house, Mr. G. K. Voight). The entangled fly also winked his eye. In this window 50 16 candle-power Imperial frosted lamps cast a mellow radiance on the goods.

Displayed in the window on Eighteenth street and Sixth avenue were the good things to be found on sale in the Book Department, six revolving pillars showing to advantage a choice line of "popular authors." These were driven by a belt and pulley system attached to a motor.

On Eighteenth street (next to the last entrance) was a clothing display. The window was trimmed in red fluted panels outlined in evergreen and tied in each corner by a white satin bow, seemingly held in place by a 16 candle-power Imperial lamp, frosted. There were 60 such lamps in this display.

The credit of the general "get-up" of the windows is due to Mr. Young, head trimmer, and of the electric effects to Mr. G. K. Voigt. It is to be borne in mind that all this lighting display was additional to the regular lighting of the store, with its thousands of incandescents, its hundreds of enclosed arcs, and its big search light. The place was as light as day all through the dark hours of the Christmas shopping season.

WAGONER, ARIZ.—Mr. Alex. O. Brodie writes us that the Walnut Grove Water Storage Company are engaged in preliminary work looking to the reconstruction of their dam, and a power transmission of considerable size. It will, however, be some time before anything is done in this direction.

THE ELECTRIC ARC FOR LANTERN PROJECTION.—III.

BY E. P. HOPKINS.

(Concluded.)

THE all important question is, how to maintain a steady, equal light.

First, at what angle should the carbons be in regard to the axis of the lenses? Should it be vertical or slanting? From experience I would say that an angle from 15 to 20 degs. is most suitable. This lamp, described in previous articles, is constructed at an angle of 16 degs. from the vertical. If the angle is too great flaming often occurs and usually at a most critical moment. I have come to the conclusion that the cause of flaming is almost entirely due to currents of air, except when a magnet is near, as in the case of an iron hood that nearly surrounds the carbons. It has been so marked with the alternating current that the flame was evidently magnetically blown back upon the center of the hood next to the body of the lamp which part became red hot, after about 20 minutes' burning without any change in the flame. I removed the hood, when there was no appearance of any flame. This principle has been used for searchlights when the horizontal carbons are used, and with very beneficial results. I have tried many experiments in this direction with a view to changing the position of the carbons, but have not come across anything that promised better work.

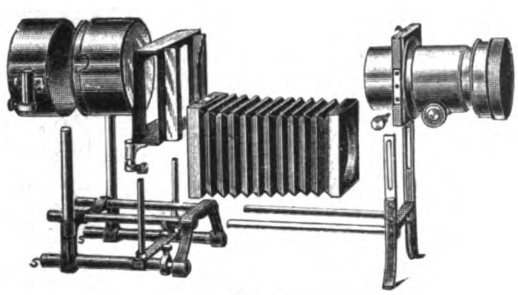


FIG. 9.

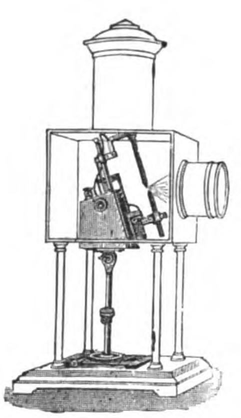


FIG. 10.

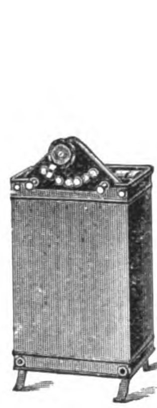


FIG. 11.

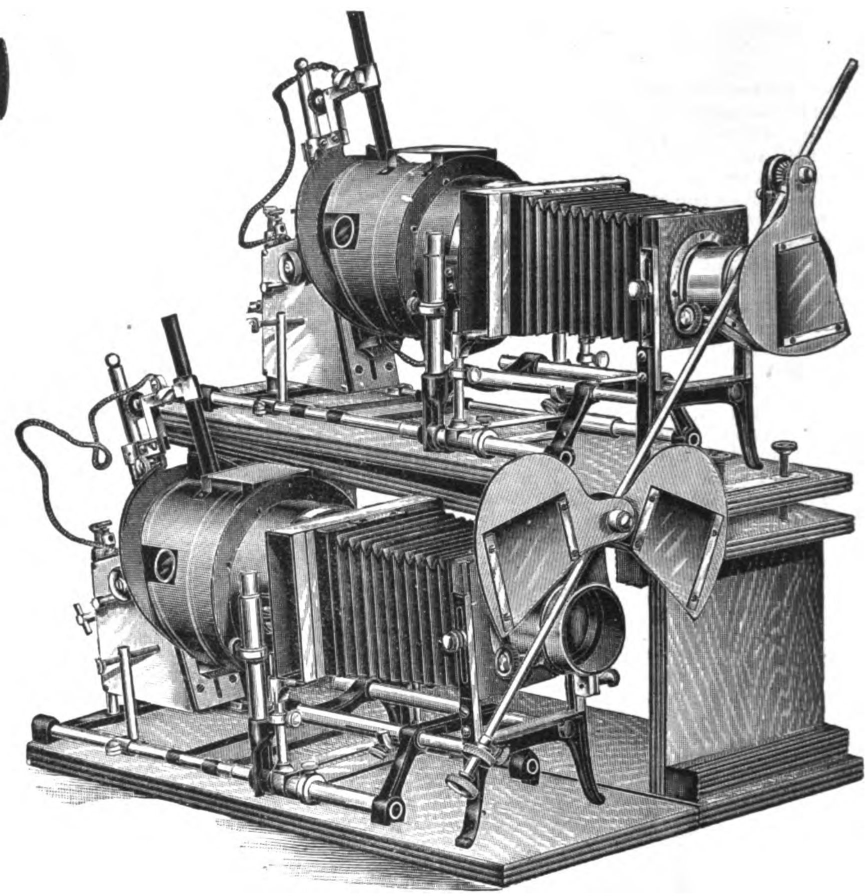


FIG. 12.—COLT DOUBLE ARC DISSOLVING LANTERN.

In order to avoid currents of air from affecting the arc and causing it to flame, an air and light shield is used, consisting of a small piece of sheet iron rivetted to the regular hood with a space cut out in front to allow the negative carbon to pass without touching. The arc is maintained ¾ inch above this shield so that currents of air cannot strike the arc directly. Flaming is sometimes caused by imperfections in the carbons, a piece chipping off and leaving a space for the arc to start up the side of the carbon. One peculiar phenomenon I have noticed and presume others have also, is that the resistance or counter e. m. f. of the arc is considerably reduced at the time of flaming, although the arc is increased in length from ¼ to ¾ or 1 inch and the current increases (naturally) if on a constant voltage circuit.

In starting a lamp with new carbons, it will be necessary, in

order to get a good equal light on the screen, to draw the upper carbon considerably behind the lower, or negative, so that the arc will be forced to the outer edge of the positive carbon and so burn that part away and form an arc in the right position. Then it will be necessary to push the carbon forward again to avoid flaming. When once the carbons have been properly formed or burnt into shape, it will not be necessary to readjust them. In Fig. 7, illustrated in a previous article, the carbons are in the best position for general work and will remain so. There are 7-16 inch Electra carbons, with soft cores, positive and negative. Solid carbons of less diameter may be used with good effect, and sometimes with better results than when both carbons are of the same diameter, but for general work I have been able to get equally good results with both arrangements, and as the former makes it much simpler for the novice, as he cannot make a mistake, the lamps are usually operated with the same sized carbons for both positive and negative. For lantern work Electra carbons are decidedly superior to any other, and I have tried all that I could get hold of. I wish some one would manufacture carbons in America that were good enough, as it is very inconvenient waiting for importation for the special size that one requires, as, of course, just the size needed is out of stock.

Fig. 9 illustrates the lantern part dissected, showing that each part can be easily removed or exchanged in case it becomes damaged. Notice should be taken of the condenser cell, which is close to and just outside its supporting collar, which is supported by side clamps on two upright posts so that the center of the lenses can be adjusted to suit the height of the illuminant. It will be noticed that the other parts, the slide box and the support of the objective lens, are adjustable in the same manner. The bellows between the two being fixed to them will, of course, move with them. For oxyhydrogen light this makes an extremely compact lantern, as the parts can be set as low as possible so that they will not take up much room, and when two or more lanterns are supported, one over the other, it makes a comparatively small piece of apparatus. The convenient detachment of the front support and lens enables what we term an optical bench to be attached in its place to the body of the lantern. On this optical bench can be placed or adjusted any system or set of lenses or apparatus that may be required for the whole field of projection work.

As many colleges and demonstrators have already on hand the rather elaborate Morton lantern, it has been found very necessary to adapt this electric lamp to that form. On account of its small size, the lamp lends itself very conveniently to its adaptation, as shown in Fig. 10. The supporting post has a sliding joint which is fixed firmly by a set screw and raised or lowered by a thumbscrew, which is threaded on the post itself. The side motion to the right or left is produced by a worm-wheel fixed to the base of the post and turned by a screw knob. The adjustment back and forth for the focus of the condensers is obtained by sliding the support of the post in a groove in the base.

Fig. 11 illustrates the compact adjustable rheostat. It consists of two iron frames, supported on feet about two inches from the ground. These frames are insulated with asbestos and stretched over them, up and down, are German silver coil springs. The case, which is Russia iron lined with asbestos, acts as a form of flue or chimney, thus causing a draught of air to pass through all the coils, so that with one frame we can dissipate with ease 1,000 watts. This frame is 8 inches wide by 12½ inches long. As this adjustable rheostat has two frames, one for adjustment and the other for the highest amount of current that the adjustment will allow, it will be 6 inches wide, but if the adjustment part is not required, only one frame is needed, in which case it will be only 3 inches wide. This clamping together of frames makes an extremely convenient form of rheostat, which can be adapted to any circuit, even that of 500 volts, which takes 7 frames. The wire of which these rheostats are made is German silver. If iron were used, and the same amount, it would become so heated that its resistance would vary greatly. I have tried the special high resistance wire of Krupp, but find that although it requires less wire, we cannot make it very much smaller on account of ventilation and the cost is very little reduced, and as German silver is a staple article on the market, and can always be obtained at a low price, it is more satisfactory.

Fig. 12 shows a pair of electric lanterns, so arranged that they can be operated at one side of the apparatus. The dissolving device is conveniently arranged by having two vanes which are supported above the lenses, which move in opposite directions by turning the bar which operates them by means of a bevel gear. These vanes are made of metal, with the center part cut away, which is covered by plates of mica which have been blackened towards the inner edge and shaded off to transparency at the outer edge. When the rod is moved, one pair of vanes is opened or separated, while with the second pair in this case, the lower lantern is brought together, and on account of the shaded mica the light is very gradually cut off from the lower lantern, and, at the same time, put on from the upper lantern, the two lanterns being registered so that they superpose their respective pictures on the same screen, as is always the case with dissolving lanterns. There was great difficulty experienced in obtaining dissolving effects with the electric light on account of not being able to adjust the brilliancy of the lamp when starting. In this case, both lamps remain burning and very effective results are produced by the dissolver in front of the lens, as above described.

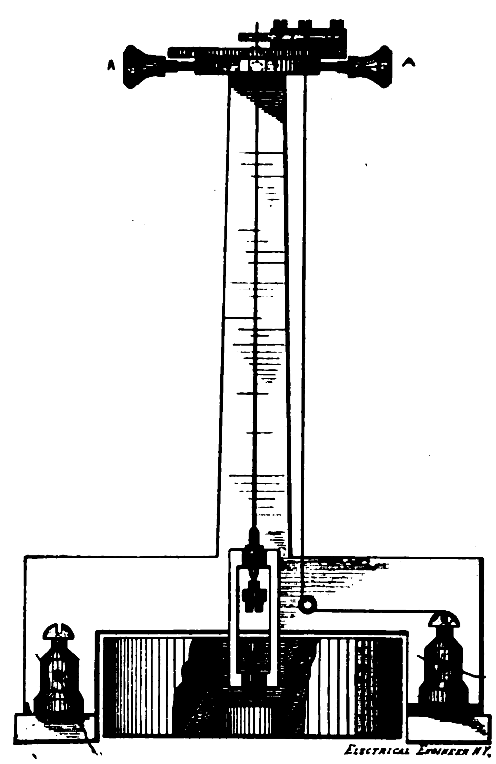
All the apparatus referred to in this article is manufactured by J. B. Colt & Co., of 117 Nassau street, New York.

MISCELLANEOUS.

THE ELECTRICAL SEISMOGRAPH AT THE WEATHER BUREAU, WASHINGTON.

BY NEVIL MONROE HOPKINS.

PERHAPS no other of the numerous pieces of apparatus at the National Weather Bureau, at Washington, has a more interesting and at the same time weird task to perform than the electrical seismograph, or recorder of the tremblings of the earth. While the instruments in use at the weather bu- of precision and measurement it would indeed be difficult to design and construct a piece of apparatus of more beauty and capable of finer adjustment. The majority of instruments in use to-day at the weather bureau are dependent on electrical circuits for their working, including the present seis-



SEISMOGRAPH IN U. S. WEATHER BUREAU, WASHINGTON, D. C.

mograph. The present instrument is shown in the illustration, being so simple in principle that a few words suffice for its description.

A heavy frame supports a cylindrical lead weight by means of a short steel stirrup having two hardened bearings allowing the weight ease of motion. A long slender pointer is rigidly connected with the upper end of the link, being tipped with platinum where it passes through a minute hole in a platinum plate. The screws A A serve to adjust the plate and are four in number. The little instrument which measures about 12 inches in height is kept under a glass shade in a stone chamber by itself in the sub-cellars of the instrument building.

The recording instrument consists of a chronograph which is situated in the second story of another building near by. Periodically an electrical circuit is closed through the system

by clock work, making a dash or offset on the paper carried by the chronograph cylinder to show that the instruments are in working order. Should seismic disturbances take place a series of dashes or offsets would be recorded showing the hour and minute of the beginning and cessation of the earth's oscillations or quakings. It is claimed that feeble tremblings of the earth, that would be of much scientific interest, would take place unobserved but for delicate means to record them, and properly designed and constructed apparatus, and last, but not least, properly installed apparatus, are sure to lead to interesting data.

The present piece of apparatus is mounted on an iron standard about three feet high which is firmly bolted to a stone slab which rests on heavy cement foundations entirely independent of those of the building. Various devices have been thought of to record disturbances of the crust of the earth, among them being a vessel of mercury imbedded in the earth serving to reflect a beam of light against a strip of sensitized paper moved by clock work. It may be interesting to note that Charleston, S. C., has made application for a seismograph, with its several attachments. The instrument just described was designed by Prof. C. F. Marvin, Professor of Meteorology, United States Weather Bureau.

ELECTRICITY IN NAVAL LIFE.—XII.

BY LIEUT. B. A. FISKE, U. S. N.

DEPRESSION POSITION FINDER.

When the ground in the vicinity of the water is high, the distance of a vessel on the water can be found simply by mounting a telescope on an eminence, pointing it at the vessel's water line, and noting the angle of depression of the telescope below the horizontal. The height being known, the distance is inversely proportional to the sine of this angle, so that the instrument may be graduated at once in yards. The direction is obtained with equal simplicity, by noting the azimuth of the telescope, as shown on a horizontal circle. To make these measurements and send them to the guns automatically is the office of the instrument hereinafter described. Corrections are, of course, needed for the rise and fall of the tide and for changes in refraction. The special limitation of this class of apparatus is the fact that the smoke of guns frequently hides a vessel's water line altogether, as was conspicuously shown at the battle of the Yalu.

The apparatus consists in two principal parts, namely, a device for determining the distance and a device for determining the direction or bearing of the object. The said two parts are used conjointly, and thereby the location of the object may be recognized upon a chart representing the area of the harbor, for example, drawn on a reduced scale.

In the accompanying drawings, Fig. 38 is a diagram illustrating the operation of the distance or range finder. Fig. 37 is a diagram illustrating the operation both of the range finder and of that part of the apparatus which shows the bearings of the distant object. Fig. 37 is a diagram illustrating the operation both of the range finder and of that part of the apparatus which shows the bearing of the distant object. Fig. 39 is a side elevation of the observer's instrument and shows the mechanism thereof on a larger scale and in detail.

Similar letters of reference indicate like parts.

Referring first to Fig. 38, A is a telescope, sight bar,, or other like means of directing the line of sight, indicated by the dotted line upon the object B. This telescope is to be located upon an elevation adjacent to the waterway to be protected. The telescope is pivoted at its outer end, so that it can be depressed through any desired angle in order to bring it to bear upon the object. The telescope is provided near its sight end with a contact piece or wiper which always bears upon a body of conducting material, represented symbolically at C. Connected with the ends of the body C is a voltaic battery, D, and connected in circuit with one end, E, of the body, C, and with the movable wiper or contact piece carried by the telescope A is a galvanometer, F. It will be apparent that as the telescope A is moved on its pivot its contact piece or wiper will be carried along the body C, and, as a consequence, a greater or less amount of the body C will be brought into the circuit which includes the galvanometer F. Inasmuch as the body C is to be constructed of, for example, a wire of uniform resistance per unit of length, it is obvious that as the telescope A is moved and a greater or less length of said wire is brought into the galvanometer circuit, the resistance thus interposed in said circuit will be increased or diminished; and as this length, and hence this resistance depends upon the angle of depression of the telescope, it becomes a function of the angle of depression; and, equally, the deflection of the galvanometer F, due to this change, is also a function of the angle of depression. Therefore, knowing the height of the telescope above the level of the object, the galvanometer deflection will indi-

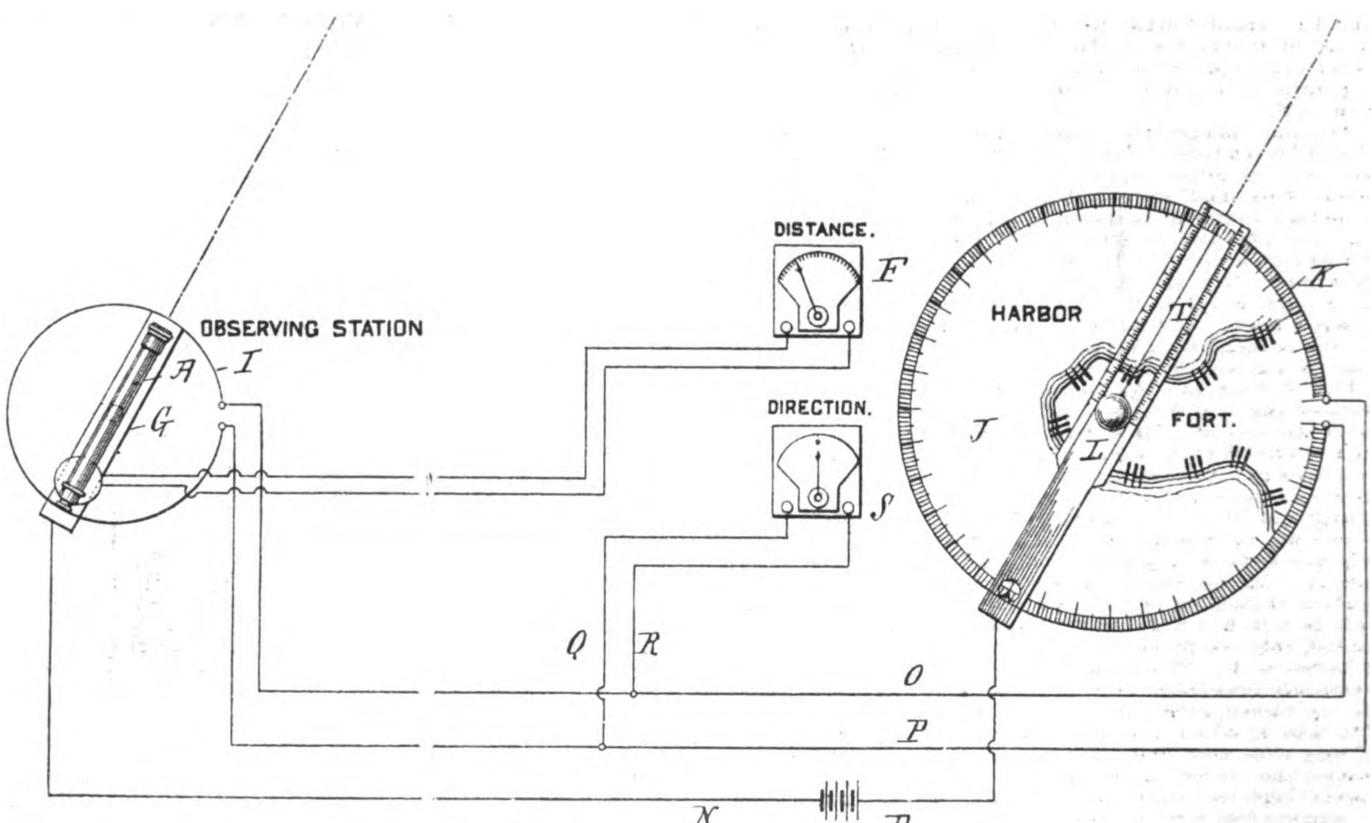
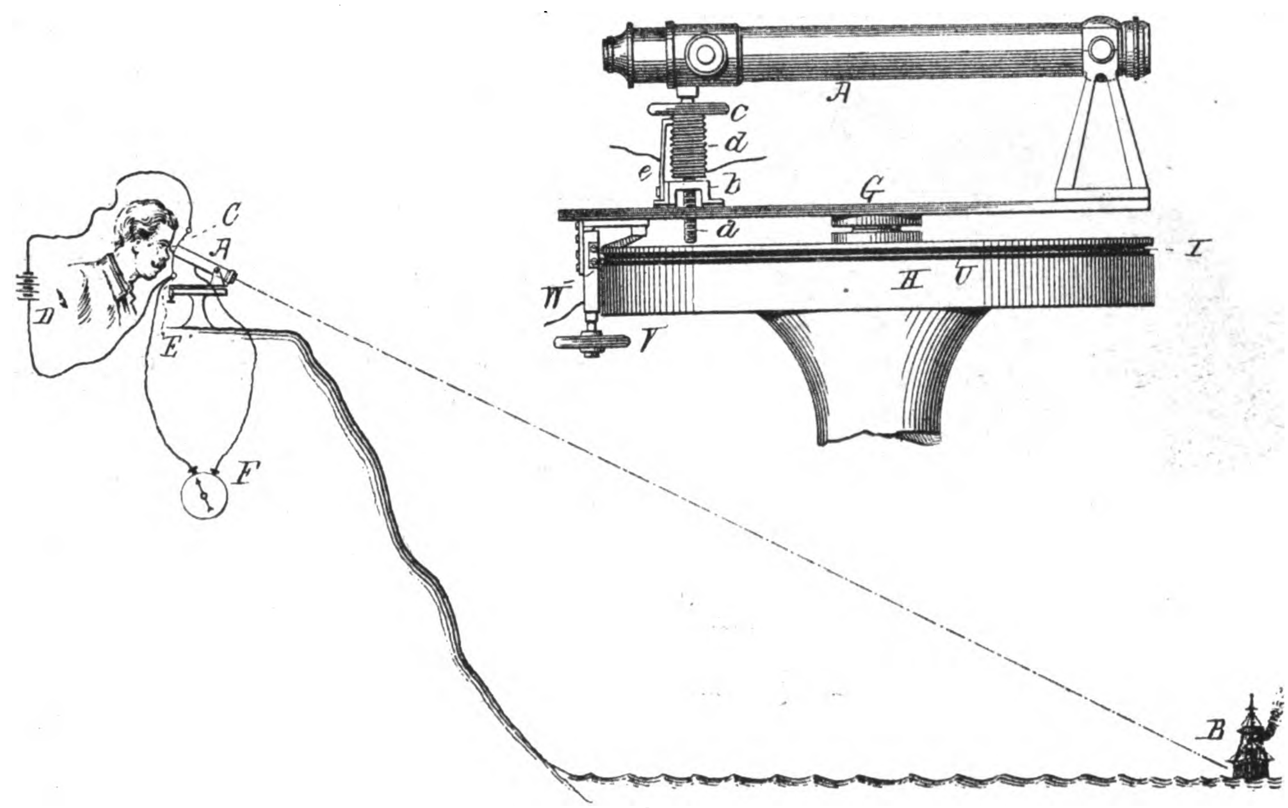


Fig. 37.—Position Finder.

cate the distance of the object from the telescope, for which purpose the galvanometer may be once for all graduated in any suitable unit, such as meters or yards. Hence, if the galvanometer be located at a station distant from that telescope, an observer at that distant station, by reading the galvanometer, can recognize at once the distance of the object, while the person stationed at the telescope has nothing to do but to keep it properly directed upon the object.

The telescope pivot is carried upon a bar G, Fig. 39, which is pivoted upon a circular table, H. Placed in a groove around the periphery of this table is a wire I, Fig. 37, of conducting material, having a uniform resistance per unit of length. Upon the bar G is supported a contact piece or wiper, as will be more particularly explained hereinafter with reference to Fig. 39, which contact piece or wiper always bears upon the wire I. At the distant station, Fig. 37, there may be arranged a circular table, J, having around its periphery a wire, K, similar in all respects to the wire I. Upon the table J is pivoted a bar, L, which bar L carries a wiper or contact point which constantly presses upon the wire K. The contact point on the bar G and the contact point on the bar L are connected by a wire, N, which also includes the battery D. The ends of the wires K and I are connected by wires O and P, and said wires O and P are respectively connected to wires Q and R, which lead to the terminals of a galvanometer, S. It will be obvious, by a simple inspection of the drawing, Fig. 37, that the wires I and K at the separated stations and the pivoted bars G and L, together with the battery and the galvanometer S, are connected in Wheatstone bridge circuit, and that a movement of either the bar L or the bar G, displacing the contact pieces over the wires K or I, will vary the resistance of the bridge arms so that the bridge may be brought into or out of equilibrium by the movement of these bars upon their pivots; and further, it will be obvious that the fact when equilibrium is produced in the bridge will be made manifest by the movement of the pointer of the galvanometer S. The construction is to be such, therefore, and the instruments at the separated stations are to be placed with reference to one another, so that when the bar L makes the same azimuth angle with reference to one end of its wire K as does the bar G, then the bridge will balance and the galvanometer S will show zero; so that if the telescope A, and consequently the bar G, parallel thereto, be directed upon the object, the galvanometer S will indicate zero when the bar L is placed similarly to the bar G. If, then, on the table J there be disposed a chart of the area to be protected on a reduced scale, such, for example, as is shown in Fig. 37, the direction of the object from the point of observation will be indicated by the position of the bar L. For convenience in this respect the bar L is made with an opening containing a longitudinal wire, T; the position of the object on the chart being of course along this wire; also on the sides of the opening in the bar L may be marked a scale of distances, in yards or meters.

The operation of the whole apparatus is therefore as follows: The telescope A is depressed, and also moved in azimuth, until aligned with the object. Inasmuch as the distance of the object depends, as has already been explained, upon the angle of depression, and as this angle is measured by the galvanometer F in terms of distance, it is plain that if the galvanometer F be located at the station distant from the observer, then from that instrument the distance of the object can at once be read off. Simultaneously the movement of the telescope A in azimuth disturbs the balance of the bridge which includes the galvanometer S. The observer at the distant station then moves the bar L until the galvanometer S, placed near to him, shows zero. When this is done, the position of the object will be somewhere along the line of the wire T; and its exact point along that wire T is immediately found by noting on the scale on the bar L the distance corresponding to that shown by the galvanometer F. The bearing and distance of the object thus being ascertained, it remains simply to communicate this information, by any suitable means, to the guns or battery.



FIGS 38 AND 39.

It will be apparent that one of the advantages of this instrument is that it is directed by a single observer, and that the simple operation of aligning it with the target instantly causes, at the distant station (the bar L being suitably manipulated) indications from which the bearing and distance of the object may at once be recognized.

Referring now to Fig. 39, there is here illustrated, in detail, the mechanical construction of the telescope A and its supports. The table H may be of any suitable material, and should have embedded in it a ring U of hard rubber or other insulating material, in which ring is the groove in which is placed the wire I. The bar G is conveniently rotated on its pivot by means of the hand wheel V, the support for which wheel carries the contact point or wiper W. The inner end of the telescope A is supported on the vertical screw a, which passes through the fixed nut b which is carried on, but insulated from, the bar G, the insulation being placed below the nut. The screw a is rotated to depress and lower the telescope by means of the hand wheel c. Secured upon the screw is a cylinder, d, of ebonite, having upon its surface a spiral groove in which is laid the german silver wire corresponding to the body C, Fig. 38. e is a contact spring which always bears upon the wire C, and this spring is supported upon, but in-

sulated from, the nut b. In this device, instead of causing the telescope A to carry the contact and move it over a fixed body, C, as in Fig. 38, the body C, by the rotation of the screw a, is made to move under the fixed contact piece e; the relation of the parts being thus merely reversed. The circuit connections are the same as is indicated in Fig. 38, that is to say, the battery terminals lead to both ends of the wire C wrapped upon the cylinder d, and the terminals of galvanometer F connect respectively with the contact wiper e and one end of the wire C. The movement of the telescope A in azimuth is three hundred and fifty degrees.

Power Transmission.

ELECTRIC HOISTS AT THE HANOVER, PENN., MINES OF THE D., L. & W. R. R.

ONE of the most interesting mine hoist installations in the country is that at the mines of the Delaware, Lackawanna and Western Railroad, at Hanover, Pa., which is hand-

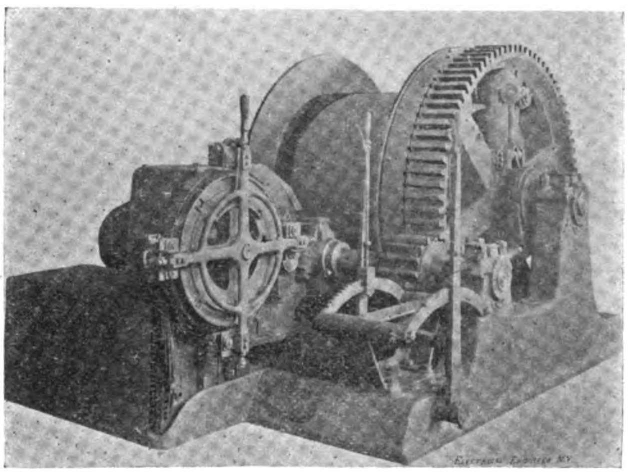


Fig. 1.—Mine Hoist Driven by Westinghouse Motor.

ling coal at a depth of 2,800 feet. There are two electrical hoists similar to that shown in Fig. 1, each capable of hand-

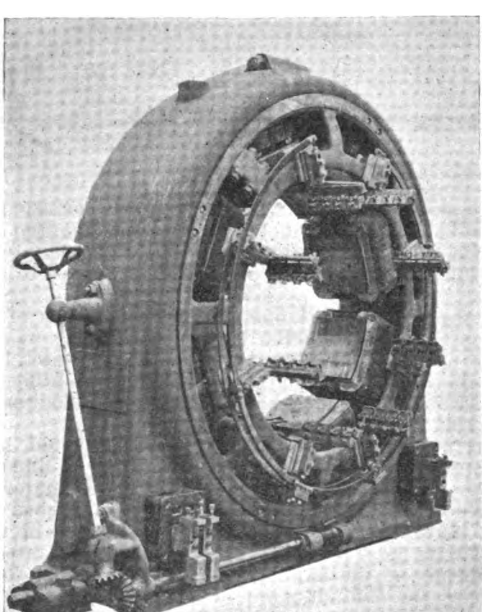


Fig. 2.—Field of Westinghouse Generator in Mine Hoisting Plant.

ling 2,800 feet of rope and hauling 10,000 pounds at a speed of 500 feet per minute up a 31 per cent. grade. These hoists, which were made by Webster, Camp & Lane, are driven by a 100-horse power Westinghouse steel motor (railway type), and the controller is of the Westinghouse commutator type. This plant, as will be seen, is very compact, the motor, the hoist and the controller being mounted on the same bed plate.

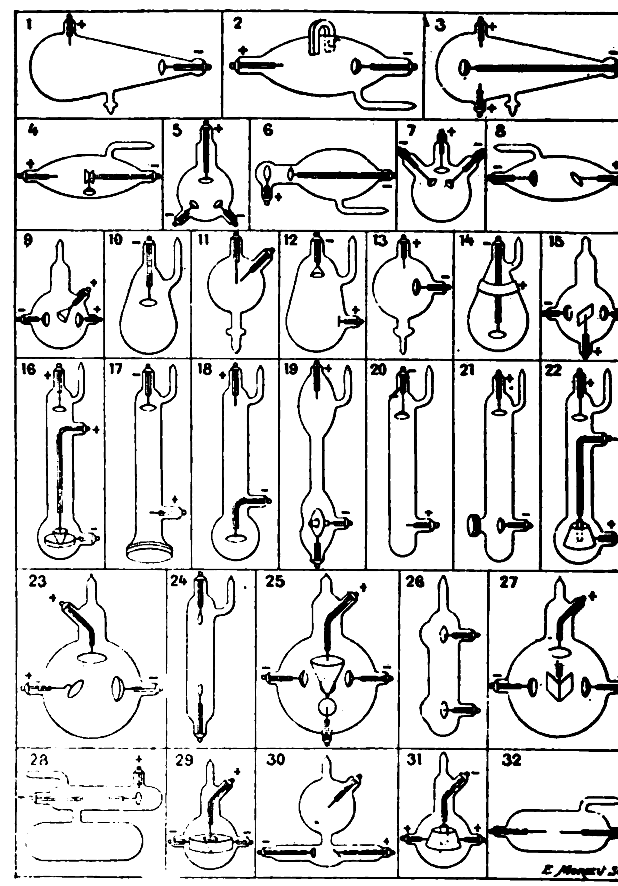
The power plant consists of a 150 k. w., 550-volt, 180 r. p. m. engine type Westinghouse generator, shown in Fig. 2, with the armature removed. This generator is driven direct by an Ames engine. There is a marble switchboard connected with the plant containing the instruments for regulating the operation of this machine. The plant has been in operation for some time, and the railroad company has expressed its great satisfaction with it.

Roentgen Rays.

VARIOUS TYPES OF X-RAY TUBES.

A LARGE number of tubes have already been employed in different experiments with, and applications of, the X-rays for photography, and in connection with the fluoroscope. Mr. G. Seguy has constructed and experimented upon several types and he has gathered a collection which is illustrated in our contemporary, "La Nature."

There exist at the present time three methods of obtaining the X-rays. That employed in the very beginning is based on the direct action of the ray. The second permits of obtaining instantaneity in the radiograph, and is based on a reflection action. The third is a result of a combination of the first two



Various Types of X-Ray Tubes.

methods. In the accompanying engravings, Nos. 1, 2, 3, 4, 6, 7, 10, 11, 12, 13, 14, 17, 18, 20, 21, 24, 26, 28 and 32 are constructed according to the principles of the first methods. Nos. 5, 8, 9, 15, 16, 23, 25, 27, 29 and 30 employ the second method; that is, the theory of the reflection of the cathode rays and of the phenomenon of internal electrolysis of the volatilized molecules. The tubes Nos. 19, 22 and 31 produce X-rays according to the two combined theories.

The numbers accompanying each tube designate the design of the various experimenters, as follows: 1 and 2, Crookes; 3, Séguy; 4, Wood; 5, Séguy; 6, Chabaud-Hurmuzescu; 7, Séguy; 8, Thomson; 9, Séguy; 10, d'Arsonval; 11, Séguy; 12, Puluj; 13, Séguy; 14, d'Arsonval; 15, Le Roux; 16, 17 and 18, Séguy; 19, de Rufz; 20, Crookes; 21, 22, 23, Séguy; 24, Röntgen; 25, Brunet-Séguy; 26, 27, Le Roux; 28, Colardeau; 29, Séguy; 30, Colardeau; 31, Séguy; 32, Röntgen.

Letters to the Editor.

THE DEFINITION OF "THERMO-ELECTRIC."

On page 651 of your last issue, Mr. Reed replies to my letter inquiring in what sense the term "thermo-electric" was used, in his former communication upon the Jacques cell. If I now understand him, he states that the thermo-electric action is not thermo-electric. I do not know of any authority for the use of the term except for electric energy produced by direct transformation of heat energy, and as Mr. Reed now states that there is no such transformation in the Jacques cell, that is equivalent to saying the action is not thermo-electric.

I cannot see that the action of the Jacques cell is any different from the action of any other electrolytic cell, as, for example, zinc-platinum in dilute acid. The fact that the Jacques cell must be raised to a certain temperature before any e. m. f. is exhibited makes no difference in the theory of its action; it simply means that at ordinary temperatures there is no oxidation of the carbon. When the proper temperature is reached an incipient oxidation takes place which causes the difference of potential between the two plates, and this difference of potential opposes further action. Now close the circuit; the accumulated charge is removed; the oxidation then goes on maintaining the current.

This is precisely what takes place in the zinc-platinum cell at ordinary temperatures. Very possibly, I may say very likely, at a sufficiently low temperature zinc would not oxidize. If so, at that temperature there would be no potential difference between the zinc and platinum of a zinc-platinum cell, and no current on closing the circuit. Then on raising the temperature to the point where zinc could be attacked, current would be generated. Assuming all this to be true, would anyone think of calling the action of such a cell thermo-electric?

New York, Dec. 24, 1896. W. A. ANTHONY.

THE EFFECT OF HARDENING PLASTIC RAIL BONDS.

I have heard it recently stated as an objection to the Edison plastic rail bond that the amalgam would sometimes harden. As I had a very long experience with the earlier forms of this alloy designed by Mr. Edison, I wish to say that on a road in Orange the bonds were mixed so as to harden and had four or five years successful use.

If a connection jarred loose from any cause the heat produced by increased resistance quickly softened the amalgam and re-established the contact. In designing the more modern form of this bond, it was decided to put in a slight excess of mercury and to allow sufficient room in the receptacle holding the alloy, to prevent its being put under pressure. This alloy when properly used, will remain plastic for years, as I can testify from long experience. If this alloy is put under pressure the excess of mercury is forced out, leaving a brilliant white metal of great density and of better conductivity than the plastic form. It readily softens under heat and will not be blackened by an arc. Roads whose joints are well maintained need not worry about contact if their plastic alloy is found hardened.

LAKE ONTARIO & RIVERSIDE RAILWAY CO.,
F. H. TIDMAN, Receiver.

Dec. 22, 1896.

CHICAGO SCHOOL OF ELECTRICITY.

My attention has been called to the fact that the Chicago School of Electricity is making use of my name in their advertisements. Such a use is altogether unauthorized. The work I did for the National School of Electricity on their "Lesson Leaves" was supposed to be for their classes entirely and was of the nature of a review of some of Prof. Jackson's writings. I have no connection with the Chicago School of Electricity and consider that their use of my name is of the nature of a breach of faith on the part of the managers of the National School of Electricity.

FREDERIC A. C. PERRINE.
Leland Stanford Junior University, Palo Alto, Cal.

RICHFORD, VT.—Mr. W. S. Foster, superintendent of the Richford Foundry Company, is lighting a town five miles away, from one of his power houses a short distance from Richford, in Canada; and he is also preparing to light another in the spring six miles from the power house. He is wishful of receiving circulars, catalogues, etc., and we shall be obliged if our friends will accommodate him.

News and Notes.

APPRENTICESHIP IN MACHINE CONSTRUCTION.

The "American Machinist," of New York, has been making an investigation of the apprenticeship question so far as it relates to those trades concerned in the production of machinery. The results are given, tabulated and in the form of letters from nearly all of the more prominent machinery building establishments and railway systems of the country, and show that, in those trades at least, apprenticeship is by no means a thing of the past, as many suppose it is, but that it is still generally practiced and believed in.

Of the 116 engine builders, machine-tool builders, railroad and locomotive shops and builders of miscellaneous machinery, replying to inquiries, nearly three-fourths take apprentices, and more than nine-tenths of these express themselves as satisfied with the workings of the system. Many of them express their approval of it in emphatic terms, and declare that apprenticeship is necessary, and that it is the duty and can be made to the advantage of every machine builder to take apprentices.

TELEPHONES AS ALARM CLOCKS.

The Johnstown, Pa., Telephone Company has all-night service at its central office, and has established in connection therewith a unique method of helping out those of its subscribers who do not care to trust themselves to get up at a certain desired hour without some outside assistance. It is a call system, something on the style of that in vogue at the hotels. The subscriber who wishes to wake at a certain hour calls up central and tells the operator, who "makes a note on 't." When the set hour arrives the operator rings up the subscriber who made the request. If he turns over and fondly imagines it's only an alarm clock he's fondly fooled, as the telephone bell will keep jingling until an answer is turned in to central, giving assurance that the sleeper is awake.

In the same manner if a physician is called for and cannot be reached, if requested he will be notified of the call as soon as he can be reached and told whence it came.

ARC LIGHT PRICES IN CANADA.

A report has been prepared as to the cost of electric lighting in various places throughout Ontario: Chatham, sixty-five lamps, all night, 23½ cents each per night; Brantford, fifty-five lights, all night, 23 cents; Cobourg, twenty-three lights, till midnight, 21 cents; Port Hope, thirty-three lamps, till midnight, 15 cents; Peterboro, all night, 25 cents; Kingston, one hundred and five lights, all night, 24¼ cents; Ingersoll, thirty-six lights, till midnight, 20 cents; Woodstock, seventy lights, till midnight, 19 cents; Belleville, sixty-one lights, all night, 24 cents; Galt, fifty lamps, till midnight, 23 cents; Hamilton, three hundred and sixty-nine lights, all night, 25 cents; Guelph, ninety lights, all night, 24½ cents; Owen Sound, thirty lamps, all night, 30 cents; London, three hundred lamps, all night, 30 cents.

A FEW TELEPHONE FIGURES.

It is estimated that to build the telephone line from Eastern Washington to Puget Sound points it will take 16,000 poles, 1,884 miles of No. 10 hard-drawn copper wire, 15,000 cross-arms and braces and 32,000 pins and insulators. The estimated cost of material and labor is $72,000.

THE ORTHOPÆDIC HOSPITAL in New York City has been equipped with a Röntgen ray apparatus.

CHICAGO DRAINAGE CANAL.—Some of the people interested in Niagara power enterprises are said to have formed the Chicago Electric Development Co. to utilize electrically the power obtainable from the water in the drainage canal. The nominal capital is $1,000,000.

NEW HAVEN, CONN.—The report of Lamp Inspector Hopkins states that the city uses on the streets 719 gas lamps, 504 naphtha lamps and 412 electric lights. The arcs on poles in the center of the city are to be placed on arms, they being now on poles. The Welsbach lights, of which there were 24 in use, are not to be adopted by the city.

ELECTRICAL WORKERS.—It is proposed by Electrical Workers' Union, No. 35, Boston, to agitate for the regulation of employment of wiremen by statutory law, on the ground of public safety.

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CONTENTS.

EFFICIENCY OF CONDUIT ELECTRIC RAILWAYS.

AFTER another session of two days the directors of the Metropolitan Traction Company last week confirmed their previous decision to equip all the remaining horse car lines under their control in New York with electricity. It seems hardly likely that the trolley will be permitted, and hence a conduit or subsurface conducting system of some kind will in all likelihood be employed. Just what system will finally triumph is a matter of speculation, but there is an embarras de richesse rather than a dearth of such from which to choose, each making claims to special advantages. There seems to be an impression lurking in the minds of many that a conduit road must of necessity prove less efficient as a whole than a trolley road. Those imbued with this idea will therefore be particularly interested in the test of a conduit road at Washington, D. C., undertaken during the latter part of 1895 by Messrs. H. G. Ogden, Jr., and F. W. Heitkamp, for the subject of their Cornell graduating thesis, an abstract of which we find in the "Sibley Journal of Mechanical Engineering." The system tested was that designed by Mr. A. N. Connett, engineer of the Metropolitan road in Washington, in which the working conductor, a steel rail, is supported on porcelain insulators, the whole being protected from water and drippings by the overhanging slot rail.

The tests included the entire equipment and showed first that at the power house an electrical horse-power is generated for 2.57 pounds of coal, a very creditable figure for the size of station here in question. The car tests showed that the average efficiency of motors, including all stops, starts and curves, was about 60 per cent., while the average efficiency when the car was running at normal speed was 76.4 per cent. These figures are as good as are obtained on most existing trolley roads, and perhaps better than are attained on a good many such roads. If the traction co-efficient of 20 pounds per ton assumed represents the true condition of the track, and other running conditions, it would appear that some improvement in railway motor design would still be desirable. It goes without saying that a motor intended to afford a wide range of speeds cannot be designed to give as high efficiency as one built for a single speed, but the results cited above would seem to show that there is still something to work for, and well worth the doing. The line tests showed drops ranging from 8 to 10.5 per cent., dependence being had solely on the working conductors without feeders. This showing, however, can hardly be taken as a criterion, for the road tested has a length of four miles, is double track, and operates only twenty-six cars, that is, on a headway of about 3 to the mile. Where the traffic is heavier, as it would be unquestionably in New York, feeders would have to be employed to prevent excessive line drop. But it is interesting to know, nevertheless, that the rail-conductor by itself, entailed a loss of less than 2½ per cent.

Naturally most inquirers will turn to the figures of leakage. On this point the investigators were required to fall back on the records of the road itself, since, as they state correctly, a record taken during one day would constitute no adequate basis for judgment. The road's records show that during the three months extending from January to April the insulation resistance of the different circuits varied according to the weather, at times being fairly low; at others very high. The average total leakage was not above 4 or 5 amperes even in stormy weather with the track covered with slush. This is a remarkably good showing considering the length of the road, and comparing very favorably with overhead work. Mention must also be made of the fact observed, namely, that the insulation resistance of the negative conductor rail was always considerably less than that of the positive rail. This behavior is probably due to some electrolytic action which may have the effect of depositing salts on the insulator, and recalls the action noted in cable testing with positive and negative battery terminal to ground.

Taken as a whole, the tests demonstrate the road to be very efficient and well able to hold its own, in this respect, with the best trolley roads of similar length and working conditions.

As we go to press we learn that the Metropolitan conduit roads will represent an expenditure mounting towards $8,000,000. The General Electric Co. has the contract for seven 800 kilowatt generators and 600 railway motors. Two stations will supply current. The engines are to be those of the Pennsylvania Iron Works; the boilers, Babcock & Wilcox; the rails, Cambria Iron Works and Pennsylvania Steel Co. The contracts for car bodies and trucks are not yet let.

THE RECENT CHICAGO BANK FAILURE.

NO small amount of excitement has been created in financial circles throughout the country by the failure of one of the large banks in Chicago, and the sympathetic collapse of a few other banks and concerns in the West. The institution enjoyed a good reputation, but appears to have violated the banking laws—to say nothing of the laws of prudence—in placing an unduly and improperly large amount of its capital in the Calumet Electric Railway, of Chicago. The great Western city had weathered all the four serious financial storms of the past three panic-stricken years in good shape, but there had long been surprise and anxiety, for Chicago has always been a city where the enterprise and courage of its people has led to an unsafe expansion of credit, so that even in normal times, the margin is not a wide one. This year the Diamond match collapse and the closing of the Stock Exchange were signs of overburden, but the city came out of that ordeal bravely, and to-day, after all is said and done, its banks are in a splendidly solid and strong condition.

It is not for us at this distance to determine the full blame attributable to the officers of the National Bank of Illinois, but it seems to us that an unfair slur has been cast by the failure on electric railway enterprise. Persistent efforts have been made to discover on what basis the Clearing House Committee fixed the appraisement at $1,500,000. On this appraisement the net loss to the bank, which had advanced nearly $2,500,000 on the Calumet securities, was practically $1,000,000, or equal to the entire capital. It is now asserted that the Bank Examiner's and later the Clearing House Committee's appraisement of $1,500,000 for the Calumet property was largely due to the testimony of Columbus R. Cummings, who is the principal owner of the South Chicago City Railway Company, which traverses much the same suburban territory that the Calumet Company does. That is about the last kind of valuation to depend upon, we should think, and so far as we have had any opportunity to judge, the Calumet road has always struck us as a good piece of property likely to increase in value rather than be subject to permanent depreciation. If the real value of the property were in question, expert advice should have been sought outside the city—certainly not from interested parties within it.

Electric railways are many of them still in an interesting stage, but while there are pessimistic opinions in abundance, we wish to put on record our belief that for the vast majority of them, with their valuable franchises, large patronage, and the experimental work behind them, a period of hardening and rising quotations is at hand. The Chicago instance proves absolutely nothing to the contrary. There may have been bad banking and poor financiering, but that is no more an argument against electricity than it is against the universal relief following Mr. McKinley's election. Even in the brightest and best of times, bad management will result in disaster, and the finest climate on earth will not offset the wild dissipation of individuals.

THE TELEPHONE IN OUR HOMES.

THE telephone has long since come to be looked upon as an indispensable adjunct to every live business office and its value for purely commercial purposes is constantly growing as the number of subscribers to the various telephone exchanges increases. Of late, also, we are glad to note a marked increase in the number of private residences in which telephones have been installed, which would appear to indicate that for distinctly social purposes as well as for the business transactions of the household, the telephone is gradually meeting with fuller appreciation.

It seems, however, that there are still other fields open to it, which are well worth cultivating, at least in the larger cities. It has often been suggested that the theatres and concert halls might, so to speak, be brought to our firesides telephonically, and this is actually done in several cities abroad, although it has, we are sorry to say, never been carried out in this country. But even this proposition dwindles into insignificance in comparison with the domestic telephone enterprise which has been in highly successful operation in Buda Pest since 1892. This is nothing less than the "Telefon Hirmondo," or Telephone Journal, which at the present moment has no fewer than 6,000 subscribers. The scope of this enterprise will thus be seen to be of the widest possible nature. Its operation is conducted according to a regular programme on schedule time, beginning at 9:30 a. m., and continuing without interruption until 10:30 p. m. During this period the subscriber hears the daily news, stock quotations, theatrical and sporting news, reports of the parliamentary proceedings, fashion news, and the like. At 7 p. m. the overture at the opera house, or that at the Volkstheater, is sent over the wires. From 8:30 to 9:30 p. m., the regular concert of the "Telephone Journal" is given. On Thursday evenings from 6 to 6:45 a children's concert is given. There is also a special programme for Sundays, including a grand concert at 4:30 p. m. In addition to the regular force at the central exchange the most prominent authors read extracts from their works and artists perform in the concert room provided for that purpose at the exchange. The latest addition to this most perfect service is an alarm which calls the subscriber to the instrument when any communication of particular importance is to be sent out over the lines. But what is probably the most remarkable thing in connection with this enterprise is the extraordinarily low price at which the service is furnished, namely, $7.20 per year, or, say, two cents a day. It is hardly possible to hope for so low a rate as this in this country, but we are certain that a paying number of subscribers could be found in every one of our cities of over half a million inhabitants, who would willingly pay four times the amount stated above for a similarly organized service. The experiment is well worth trying, and we commend it once again to the attention of our telephone friends.

THE ANACONDA ELECTROLYTIC WORK.

THE annual report of the Anaconda copper mine just presented is very interesting from the fact that electrolysis plays so large a part in the work. This Montana property has exceeded 100,000,000 pounds of copper per year while the great Calumet and Hecla mine in the Lake Superior region shows up with but 90,000,000. On total receipts of $17,000,000 the Anaconda property shows a profit balance for the year of about $4,250,000, and is paying 10 per cent. on its present capital of $30,000,000. It appears that the refining plant can take care of 6,000,000 pounds of copper per month, or 3,000 tons. On a basis of 200 tons of refined copper per day, the copper would yield 350,000 ounces of silver per month and 1,500 ounces of gold; and it is noteworthy that the Anaconda property, in addition to its 107,000,000 pounds of copper is given credit in the report for 5,308,955 ounces of silver and 18,300 ounces of gold, which would represent about $3,500,000.

To disentangle all the figures of the report is impossible, but it may be said, broadly, that the working of the Anaconda property puts the gross copper cost at 11 cents per pound, and that the net cost is about 7½ cents. The Calumet and Hecla production still compares favorably with the Anaconda as to costs, but there is every indication in the report that the electrolytic methods recently introduced, to which we called attention last September, render possible a very economical and profitable handling of the great enterprise. A very slight advance in the price of copper, such as seems possible, would increase greatly the company's net revenue, one cent more per pound, meaning over a million dollars in additional income.

Telephony and Telegraphy.

MILITARY TELEGRAPH LINE FROM BISBEE TO SAN BERNARDINO, ARIZONA.

BY CAPTAIN W. A. GLASSFORD, U. S. SIGNAL CORPS.

THE running down of marauding Indians demands means of quick communication. The heliograph, or sun telegraph, in a sunshine region like Arizona, meets usual needs, especially when operations are over an extensive terrain and their field is continually changing. By sunflash signals the war with Geronimo was brought to a successful close. With signaling parties on prominent summits and a signalman with each moving body of troops it is easy to maintain an intercommunication which embraces every detachment.

The scene of the present Indian trouble is almost limited to the Chiricahua range, which runs south from Arizona along its eastern boundary into Mexico. These mountains are most rugged in character. The Indians can pass from Mexico along the highest ridges of this range quite unobserved, and make incursions far north of the Mexican boundary before information of their presence can be known without more speedy and permanent means of communication than heretofore existed. It was for this reason that the military telegraph line from Bisbee to San Bernardino, Arizona, was built. Cavalry and infantry, with Indian scouts, are now camped along the highest ridges of this range quite unobserved, and a band of Indians cannot get far before their trail is observed, and as soon as observed word is flashed or carried to the terminal telegraph station at San Bernardino, where the main camp of the troops is located.

From this point the military telegraph line connects with the commercial system of the country, which reaches all posts and department headquarters.

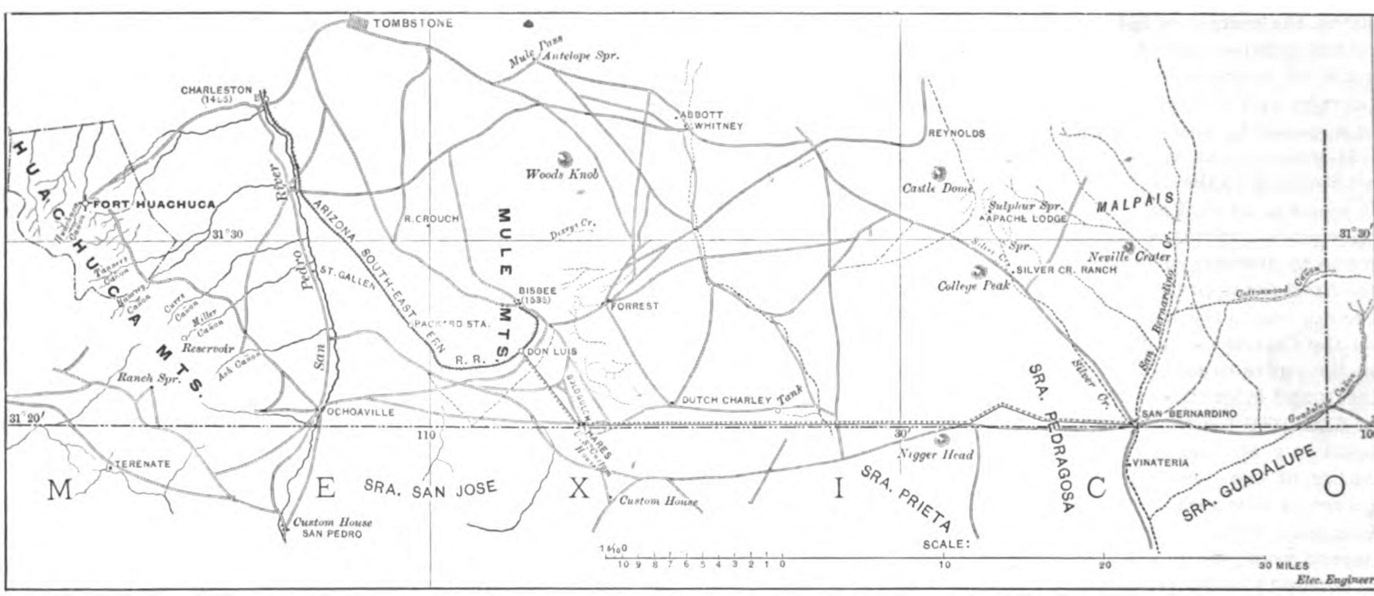
The matter of observing Indian trails is one of the most difficult problems the troops have to contend with; and really can only be satisfactorily done by Indian scouts enlisted in the service of the United States from the peaceful tribes. A band of hostiles crossing a rugged mountain over rocky cliffs generally leaves no marks that are observable to the eye of a soldier, but to the Indian scout the turning of a rock, or the disturbance of the slightest object on the ground, seems as an open book. He not only knows therefrom the time intervening between the disturbance of the object and the moment at which he observed it, but the number of the band and whether their movements were slow or rapid can be told.

The Signal Corps has, since 1873, maintained long stretches of military telegraph lines; but when commercial lines parallel them, usually along new railroads, the military lines give way, or, as frontier posts are abandoned, the military lines thereto are taken down. The post of Fort Stanton, New Mexico, near the Mescalero Apache Indian Reservation, was abandoned nearly a year ago, and the military telegraph line connecting that post with the railroad wires at Carthage and San Antonio, New Mexico—on the Santa Fé Railroad—was taken down and the material stored. Out of this material a new telegraph line was built this summer from Fort Grant to Mammoth, Ariz., to aid in intercepting hostile renegade Indians; and from the remaining material the line from Bisbee to San Bernardino, Ariz., has just been built. Military telegraph lines are built of tubular iron poles about 20 feet in length and nearly three inches in diameter, each weighing 72 pounds; ordinary No. 9 wire is also most frequently used.

Bisbee is situated in the Mule Mountains and is the location of the great Copper Queen mine (see map). The owners of the mine have a railroad, with telegraph line, 55 miles in length, to Benson on the Southern Pacific Railroad. The "Stilt City" as I have heard it called, would be a more appropriate name for Bisbee, for the town is built on the sides of a narrow canyon and the houses are upon terraces on the mountain sides, the front of many houses being held up by timbers where the slope sometimes is 30 degs.

The difficulty of approach for wagons to the railroad station at Bisbee made it advantageous to place the military wire on the poles of the railroad line, which was done to Don Luis station 4 miles from Bisbee down the mountain and outside the canyon. At Don Luis, therefore, the telegraph material was unloaded from the cars, to be carried thence by army wagons to its place of erection. From Don Luis there is a gradual downward slope to the Mexican boundary, and the telegraph line was built from that station to the U. S. Custom House on the Arizona-Mexico boundary in a direct line six and one-quarter miles. From the Custom House a direct line east, twenty-four miles in length, was built, parallel to and 200 yards north of the boundary monuments, which latter are placed along the United States-Mexican boundary at irregular intervals, several miles apart, but always so placed that the monument on either side of the one at which an observer stands is visible. This line of poles in perfect alignment passed almost due west over a spur of the Mule Mountains into the south end of the Sulphur Spring Valley; the end of this stretch of 24 miles of line being at the base of the Niggerhead Mountain, a conspicuous peak in the Swisshelm range. At the latter point the line had to make an angle so as to nearly follow the winding road which was made along the trail as we progressed through these mountains; and two additional curves were necessary as we emerged from those mountains. San Bernardino, which is only a very extensive cattle ranch, was then in sight, nine miles distant, and to that point another straight line of poles was erected. It will be seen that the line consists of 5 tangents, 2 angles and 2 curves; and is about 40 miles in length from Don Luis. Its erection was considerably retarded by unusually heavy rains which resulted in floods that made the trail impassable for our wagons; but, notwithstanding this, the line was entirely completed between the commencement of work on October 15, and November 10. The route of the line is shown on the accompanying map.

To erect such a line over such a country and transport the necessary material and supplies there were detached from troops at military posts 2 sergeants of the Signal Corps and 31 men, with one Indian scout for guide; also, two six-mule wagons, two four mule wagons and seven horses. The equipment of tools consisted of digging bars,



MAP SHOWING ROUTE OF U. S. MILITARY TELEGRAPH LINE, ARIZONA.

picks, shovels, axes, blasting material (as we occasionally had to use dynamite to blast holes for the poles), and the usual line working appliances. The detachment was divided into gangs for surveying and staking, digging holes and erecting poles, and stringing the wire. The bulk of the labor, such as the digging, was done by colored troops, who constitute the best possible force for doing work entailing hard manual labor. The effort was made to keep the gangs closely together; and if the work of one gang advanced more than that of another men were taken from the former and put with the gang which was falling behind. This enabled a constant personal supervision and oversight of the work of each party to be kept up by the officer in charge. Under a conjunction of favorable conditions there was erected in the lower Sulphur Springs Valley during one day five miles of completed line—the entire work of surveying the line, digging the holes, erecting the poles, etc., having been done that day. It should be remembered that over this stretch of country there was no road—only an occasional trail. As the work progressed, however, trimmers with axes advanced with the surveyors and cut a swath in the chapparal of sage brush and mesquite which covers the whole of Arizona. Our wagons in hauling and distributing the material along the line so trimmed out soon made a highway, which is now being used by troops, etc., traveling that way.

The want of water was one of the serious drawbacks, as streams or water holes are only found at long intervals. Kegs were supplied, and in these water was carried with the working parties as they progressed; and whenever far from a water supply dry camps had to be made dependence was had entirely upon water so carried. Ten ten-gallon kegs were available for this use. Under such circumstances not much was used for personal ablution.

In building this telegraph line it was deemed best to lay it out carefully, hence a surveyor's transit was used, and stakes set beside each point selected for placing each pole. The pole raisers by setting the poles accurately on the line of stakes were able to preserve a perfect alignment. By such long tangents and perfect adjustment to a straight line, as the poles could be thus placed farther apart, there resulted an economy in material; and, as there is less strain on a line when it is straight, there will be less chance of interruption in the working of the line. The latter is an important feature where a line passes through stretches of uninhabited country.

The wire for this line having been before used, and in taking down the old line the wire having been coiled in bundles of different sizes, it was found that the collapsible reel known as the "Little Giant" was of great availability in that particular feature, as it is capable of handling coils of varying diameter. In this matter of the reel there is an illustration of the peculiar fact of the frequent development by different persons of a similar idea or invention. When the line between Fort Stanton and Carthage was about to be taken down, the necessity of a collapsible reel appealed to the writer, who set to work to design one. One day while the reel so designed was being constructed, on going into a hardware store to purchase some bolts there was found the advertisement and picture of the "Little Giant" reel. Its similarity to the writer's design was remarkable—it was almost identical.

There was used for boring pole holes another device, entirely new, as far as known. It consisted of a hardened steel cone 6 inches long from apex to base, the base being 3 inches in diameter—a trifle larger than the diameter of the iron poles; screw flanges of a boring bit similar to those on the point of an auger were made upon the cone surface. Into the base of the cone was fastened an iron bar about 4 feet long, at the end of which bar was placed a handle similar to that of an auger. In ground devoid of gravel, this ground-boring-bit could be screwed down into the earth, and the soil, instead of coming up as in the case of an ordinary auger, was compressed all around the hole as the auger bit was driven down. Holes thus made would receive the pole snugly, and the compression of the soil under the ground served to make the pole firm and much more stable than when the hole was dug and then the loose earth thrown in and tamped. In some soils such a boring bit would be invaluable for such work, for a hole can be made in a short time with a minimum of labor.

These military telegraph lines serve an important purpose not only in aiding to prevent marauding raids of Indians but also as a means of promoting the business interests of the sections through which these lines run, as a channel of quick and cheap communication. It is the policy of the Signal Corps to charge only a nominal rate for business telegrams, consequently a great impetus to settlement, and to mining interests, has frequently been given thereby.

CHICAGO, ILL.—Electric power for drawbridges is to be adopted for all the bridges over the Chicago River at Chicago, replacing the steam plants now required for each bridge.

NEW ELECTRIC BELL BUOY IN BOSTON HARBOR.

THE risks attending the navigation of vessels in and out of Boston Harbor have long been known to mariners, and this was emphasized in a startling manner by the disaster which occurred to the big freight steamer "Venetian," belonging to the Leyland Line, which, on leaving the harbor on Saturday, March 13, 1895, ran on State Ledge and broke in two amidships, entailing a loss of something like $385,000,

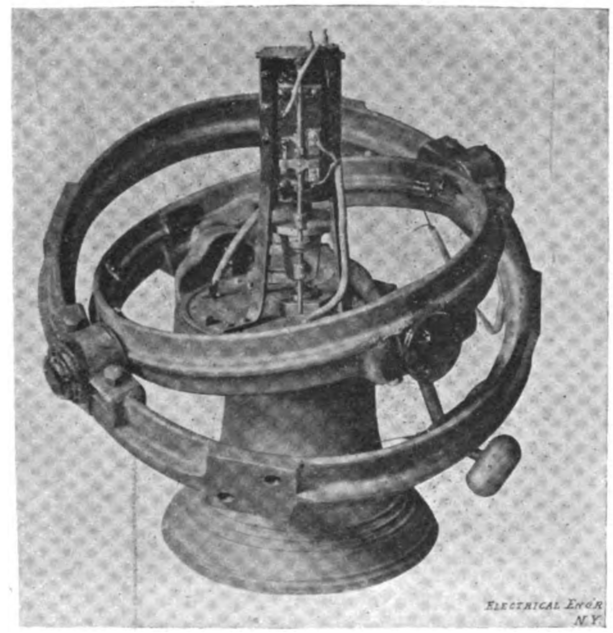


Fig. 1.—Electric Bell Buoy, Boston Harbor.

and imperilling navigation from that date until now, for the last of her has not yet been removed.

This and other mishaps of lesser magnitude prompted more than one inventor to solve the problem of rendering navigation safe at all times and under all conditions. And it would appear that the problem is in process of immediate solution, even if it has not already been solved, by an electrical inven-

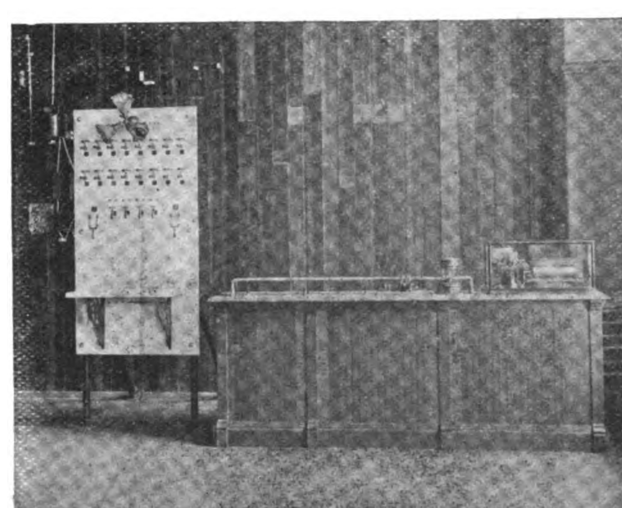


Fig. 2.—Electric Buoy, Central Station, Boston Harbor.

tion, due to Mr. John A. Fairbanks. The apparatus is being developed and installed by the Fairbanks Electric Bell Buoy Company, the perfecting and building of the whole having been entrusted to Messrs. Murdock & Faber, the well known telephone engineers of Boston.

For over a year the work has been in progress, and having been completed, the Federal Government has granted permission to place three of these electric bell buoys at different

points along the deep water channel in Boston Harbor, all of which are operated from Castle Island, now used as one of the city parks. These buoys have been anchored as follows: At Nixey's Mate, 3¼ nautical miles; State Ledge, ¾ mile; and Upper Middle Ground, 1 mile from the operating station. A 500 volt current is used, and this is taken from the arc light circuit with which the Boston Electric Light Company illuminates Castle Island.

For conveying the current from the island to the buoys and return, a cable made by the Safety Insulated Wire and Cable Company, of New York, is used. The cable is of the following construction: Three conductors, each composed of seven strands, equaling No. 12 B. & S. gauge, having an outside diameter of about .33 of an inch, with an insulation resistance of 800 megohms per mile. These conductors have a double covering of jute, over which is a heavy steel armor.

Besides the many difficulties to be contended with in the construction of the apparatus, there was a further important matter to be dealt with. The bell might be struck regularly and perform its function accurately under all conditions, yet how to render it even more efficient and trustworthy, helpful to mariners navigating their ships to and fro, and at the same time automatically recording its own operations for reference in case of an emergency (?). This has all been provided for, so that every blow struck by the electrically operated hammer on the bell is unerringly recorded in the station in Castle Island.

To aid our readers in arriving at a clear understanding of the principles according to which this useful piece of apparatus has been constructed, we illustrate the bell, and also the operating room on Castle Island.

Fig. 1 shows the bell as it is hung on an universal joint. The magnet also is shown. This consists of an iron clad solenoid and plunger on the lower end of which is a soft iron disc of exactly the same diameter as the iron case. On the bottom of the disc is a forked composition casting, through which passes one end of the hammer lever, which is also forked. This works on a roller bearing. To the bottom of the under tine or prong is fastened a flat spring of phosphor bronze which curves over the end and lies parallel to, but not touching, the top side of the tine and into a slot in the shank. This spring gives the rebound to the hammer and allows of a clear ringing tone from the bell. On the long arm of the lever is a 2¼-pound hammer, the bell itself weighing 100 pounds.

On the side of the magnet may be seen a switch, the various parts of which are made of phosphor bronze, the purpose of the switch being to shunt the current from the lower conductor to the upper one, which is connected to the registering device at the shore end of the circuit. The plunger of the solenoid is protected against rusting by a thin brass tube which is slid into place while hot and afterwards trued up in a lathe. The other parts, which are made of iron, are heavily plated, and where it is practicable, painted and covered with vaseline, while a dome of cast iron—not shown—covers the whole and is held down to a gasket on the bed plate by four bolts.

The buoys that have thus been electrically equipped are of what is known as the 2d class gas buoy type, that being the most stable type for a rough sea. This type of buoy is conical in shape, the apex being cut off at a point where the diameter is about 30 inches. Four upright standards of channel iron support the bell. Near the top and on one side of the buoy is a manhole.

From the center of the base extends an iron pipe of considerable diameter which supports a two-ton weight to keep the buoy in an upright position. This weight, or anchor, has a 2½-inch hole through its entire length, and at its upper end a pipe of the same size is screwed in and extended up to the top of the buoy, where it enters a junction box. This junction box is a rectangular casting having two chambers separated by a wall of iron, and securely bolted to the under side of the plate which forms the top of the buoy.

One of the spaces in the box is the outlet of the pipe through which the cable is brought in. The other space is used to make the splices connecting the cable to the wiring of the bell. These wires pass through a small box and up one of the standards to the outside ring, where they pass through the center of the trunnion by means of a switch to the inside ring, and thence inside the dome by a second switch.

These switches are made of phosphor bronze mounted on hard rubber covered by a cap to keep out water. The cable passes through the large weight and pipe to the junction box, where it is held by a clamp made in two pieces secured together by four bolts.

The ends of the armor are left long and turned down around the sides of the clamp and bent into a groove and held there by a second clamp of wrought iron.

The current is distributed to the three buoys from a marble switchboard, shown in Fig. 2. One side of the circuit is connected with the drum of the circuit breaker and as contact is made continues out to the magnet and returns through the lower blade of the switch and conductor connected thereto; but as the current energizes the magnet and completes the stroke of the hammer on the bell, the switch operates and sends the current through the other conductor and registering magnet, which indicates and records the blow on a paper ribbon as it feeds along. The amount of current used in striking a blow and running the motor is 1.4 amperes.

A one-eighth horse-power electric motor of the Holtzer-Cabot type is connected to the circuit breaker by means of worm gears, whereby the speed is reduced from 1,500 revolutions to one per minute. This motor also operates the paper feeding device by means of a shaft running under the cabinet. Alongside the motor is a time stamp which records automatically the minute, hour, day, week, month and year; also the words, "tested," "started," "stopped." etc., on the paper, so that a complete and permanent record is thus kept for future reference.

The buoy being regulated to strike various combinations or groups of strokes, at stated intervals, pilots and captains may discover their exact location and promptly get their bearings for the next buoy.

SIGNALS FROM MARS.

Sir Francis Galton declares in an article in the London "Fortnightly Review" that somebody on the planet Mars is signaling to us by means of dots and dashes of light, produced by something like heliographs. It is a pretty good yarn, and only the name of the distinguished English scientist gives it a sober aspect.

It is said that one of the great European observatories prepares a recording apparatus, which is found to perform its mission effectively. A long strip of telegraph paper is slowly drawn by clockwork under a hinged pencil, on which the observer rests his finger. When the scintillation or flash is on he presses with his finger and the pencil leaves a mark. When the flash is off, he ceases to press, a spring lifts the pencil and a blank is left on the traveling slip of paper.

An examination of these telegraphic ribbons shows that three, and only three, different signals are employed by the Martian operators, who are now working splendidly under an uncommonly intelligent director of works.

These signals differ only in their lengths and resemble the dots and dashes of the telegraphic code.

The dot lasts one second and a quarter. The dash lasts two seconds and a half. The line, or longest dash, lasts five seconds.

After a few well marked succession of dots, dashes and lines it is ascertained that the interval between letters is one second and a half, the interval between words three seconds and the interval between paragraphs six seconds.

As there are only three varieties of signals, the total number of different words of one letter is three, of two letters nine, of three letters twenty-seven, of four letters eighty-one, of five letters 243 and so on in geometrical progression. The average time occupied in signalling these words, including the three seconds pause at the end of each, are six, ten, fifteen, twenty and twenty-four seconds respectively. The Mars folk evidently intend to speak to us in very terse and pointed language.

YOUNGSTOWN, O.—The local telephone service of the Central Union Telephone Co. is being very much improved, and Mr. W. W. Johnston, the manager, says that $40,000 will be spent in improvements. The exchange has 700 subscribers and is adding accommodation for 600 more, of whom 164 have been secured.

THE SOUTH BEND, IND., TELEPHONE COMPANY publishes in a local paper its full list of over 500 subscribers. It has a 20-year franchise with restrictions as to rates, etc. The system is metallic circuit and the instruments are Stromberg-Carlson long-distance type.

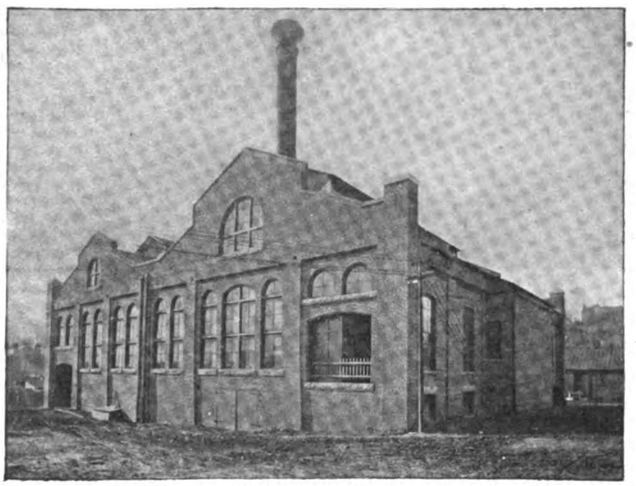
THE POSTAL TELEGRAPH COMPANY has been preparing for the Smithsonian Institution the telegraphic apparatus furnished by it to Mr. Edison and Mr. E. D. Adams for the message around the world at the recent Electrical Exhibition. The Smithsonian has secured other apparatus relating to features of that memorable show of historical and modern apparatus.

MORRIS PLAINS, N. J.—The hospital has put in a telephone system with switchboard and forty-two stations, the board being located in the office of the institution.

Electric Transportation.

THE RICHMOND TRACTION CO'S RAILWAY SYSTEM.

RICHMOND, Va. is now generally looked upon as the place where electric railroading on the modern extended scale was first practically and commercially demonstrated. Many important details of electric railway work were there first

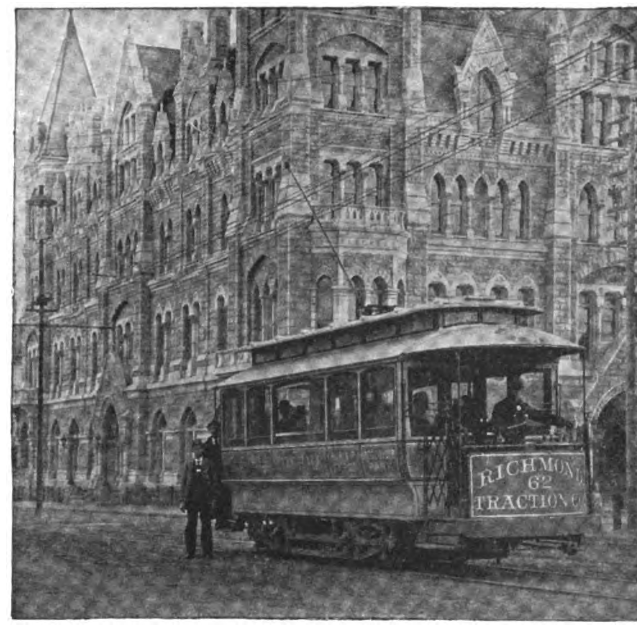


Power House, Richmond Traction Co.

called into life and many of them are still standard practice. To those who recall the first Sprague road there, the description of the latest electric railway system there, that of the Richmond Traction Company, will be of more than usual interest.

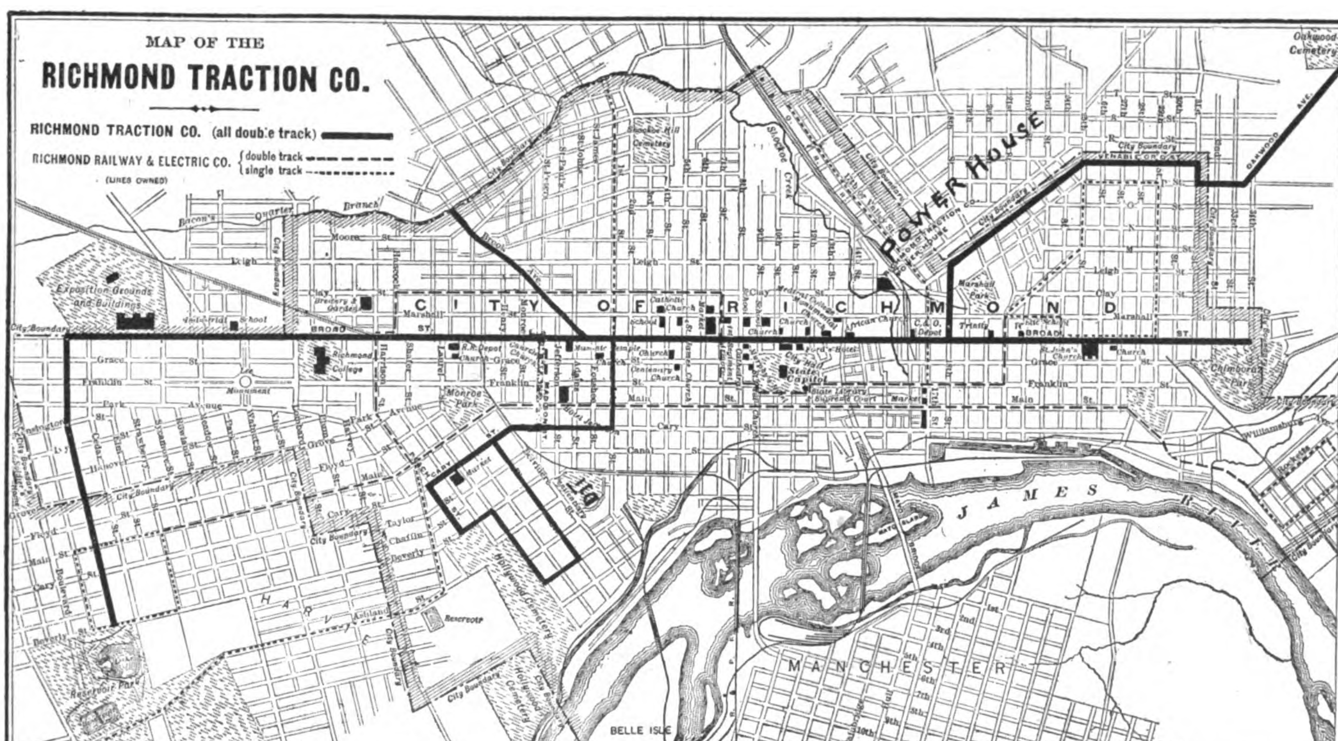
THE ROUTE.

The main line of the road extends from east to west, the full length of Broad street, the widest street and principal thoroughfare of the city. It connects the two sections of the city, the east and west ends, which are separated by a broad, deep valley, where the only grades of any consequence exist. On the east slope the grade is about 1,500 feet long and is on an average 8 per cent., except for about 300 feet, where it is 10 $^5/_{10}$ per cent. On the west side it is about the same length and averages 9 per cent. The branch line from Eighteenth and Broad streets, extending to Oakwood Cemetery, is about one and one-half miles long. Another branch line now under construction, from First and Broad street, south and west to Hollywood Cemetery, is about one and one-half miles long; another branch through Brook avenue to the city limits will shortly be built. When the branches are completed there will



Car of the Richmond Traction Co.

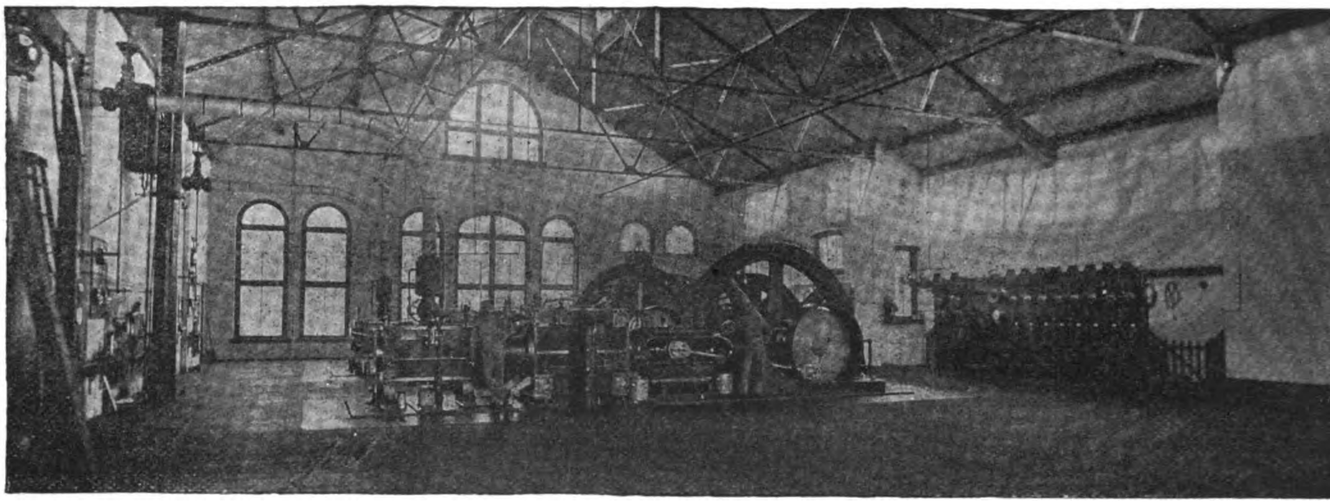
be about 15 miles of track. The accompanying map shows the route of the existing lines in Richmond.



Tracks of the Richmond Traction Co.

TRACK.

The rails are 95 pounds, groove, girder, furnished by the Johnson Co. The cross ties are 6 by 8, 7 feet long, white oak, spaced 2½ feet between centers. The track on all paved streets is laid in concrete, 6 inches under tie, and to the top of the same. The space between the web of the rail is filled with concrete, which method of construction was required by

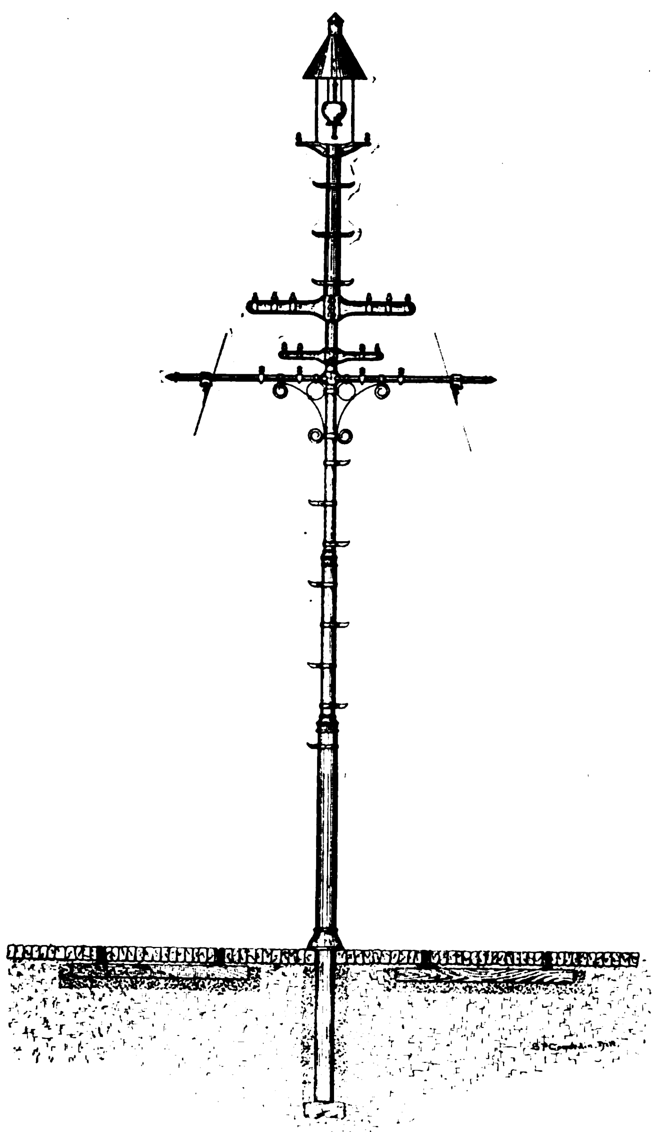


INTERIOR OF POWER HOUSE, RICHMOND TRACTION CO.

the city ordinance. The Johnston rail bond which was recently awarded the John Scott Medal by the city of Philadelphia through the Franklin Institute, is used.

OVERHEAD CONSTRUCTION.

The overhead construction is very neat and ornamental, and



RICHMOND TRACTION CENTER POLE WITH ARC LAMP.

on account of the width of Broad street (120 feet) center pole construction is principally used, the tracks being spaced 8 feet between the inside rails. At the intersection of the streets the center pole is used also as an electric light pole, as is shown by the accompanying engravings. No. 0 trolley wire and No. 00 to 0000 feed, furnished by Roebling, is used; the overhead material was furnished by the Ohio Brass Co. The Walker mechanical clip is used throughout.

CARS.

There are 26 summer cars of the American Car Company and 22 closed cars, furnished by the Stephenson Company, and the St. Louis Car Company. They have recently added two extra handsome single revolving seat cars, made by the American Car Company and which are very popular; the Peckham trucks and New Haven double car registers are used.

Each car is equipped with two 1,000 General Electric motors; this large size was selected on account of the heavy

A. L. JOHNSTON.

grades, and has proved very successful and up to the present time not a single armature has been burnt out.

POWER HOUSE.

This is situated in the valley, at the bottom of the grade, a short distance off the line, as shown by the map. It is a solid brick building, fireproof with an iron truss roof covered with slate. It contains two 250 horse-power compound condensing Hamilton-Corliss engines, speeded to 100 revolutions per minute, direct connected to 300 kilowatt General Electric multipolar generator. Steam is furnished by two 300 horse-power Campbell & Zell water tube safety boilers, in separate batteries. Deane condensers and Worthington pumps are used. The General Electric standard generator and feeder panels are used, with a center panel containing a recording wattmeter, volt and amperemeter.

CAR HOUSE.

The car house is situated at the west end of the road, near the reservoir park, and is a fireproof building, large enough for about 80 cars, the rear of the car house is partitioned off for the repair shop.

Construction was commenced in November, 1895, and the road put in operation June 20, 1896, in time for the Confederate Veterans' Reunion, and 45,000 passengers were carried daily for a week without a hitch or accident of any kind. The officers of the company are: John S. Williams, president; W. M. Habliston, vice-president and general manager; R. Lancaster Williams, treasurer; Addison Cook, auditor; E. J. Willis, superintendent. During the construction, Mr. A. Langstaff Johnston was consulting engineer, with S. P. Cowardin as assistant in charge of track construction, and R. P. King in charge of overhead construction; Jas. F. Bradley, of Manchester, Va., was the general contractor for the laying of tracks. In 1889, Mr. Johnston built the Rich. and Seven Pines Electric Railway, extending to the battlefields about Richmond. In 1890 he built the Richmond and South Side Electric Railway and laid out, in connection with the railway, Woodland Heights and Forest Hill Park.

He has since that time constructed the New Orleans and Carrollton Railway, 20 miles in length, the first electrically operated road in New Orleans. After the completion of this work he accepted a position with the Hestonville, Mantua and Fairmount Passenger Railroad Company, one of the oldest car lines in Philadelphia. The electrical equipment of the system was begun in 1893 in conformity to the plans of Mr. Johnston, which embodied many features of mechanical and electric interest. He also constructed the Fairmount Park and Haddington Railway, now part of the Hestonville system. The Norfolk and Ocean View Railway, at Norfolk, Va., was changed from steam to electricity in 1895 by him.

Mr. Johnston has won distinction by the invention of a number of ingenious devices which are now well known in street railway practice, and was recently awarded by the city of Philadelphia through the Franklin Institute, the John Scott medal of merit for his method of bonding rails.

Mr. Johnston is a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers, and the Franklin Institute.

Mr. Johnston has been a prominent street railway engineer ever since the practicability of applying electricity as a motive power was conclusively demonstrated by the successful operation of the Richmond and Union Passenger Railway in 1887. The work of drawing up the plans of the difficult track work, etc., was intrusted to Mr. Johnston, by Mr. Sprague, and his reputation as a skillful street railway engineer has dated from the successful completion of that pioneer railway installation. Since that time he has been continuously engaged in the street railway field.

FIGURES OF LIVERPOOL ELECTRIC ELEVATED.

The passengers carried by the Liverpool (England) elevated railroad in the year which ended in June was 7,519,950, against 7,101,430 the preceding year. The road issues first and second class and workmen's tickets. In the last half year less than one-eighth of the passengers traveled first class, and 27 per cent. traveled on workmen's tickets. Dividends have been paid in successive half years at the rate of 2, 2¼, 3½ and 2¾ per cent., successively.

MR. EMIL KOLBEN, chief engineer of the Oerlikon Works, Switzerland, has resigned his position.

HENRY'S SINGLE WIRE DOUBLE TRACK ELECTRIC RAILWAY SYSTEM.

NOTWITHSTANDING the magnificent record made by the overhead wire electric railway whose growth has been without a parallel in the arts, it is a fact that cannot be disguised that in the opinion of many the exposed street constructions in the way of poles and wires should be dispensed with. The opinion is so strong in certain congested districts that the railway companies are seriously hampered, and are unable to furnish as efficient a service as the more sparsely settled portions enjoy. To meet those objections without sacrificing any of the well-known advantages of the trolley system is the main object of a plan recently brought out by Mr. John C. Henry, of Denver, Colo. The construction referred to meets the opposition half way by dispensing with one-half of the poles and wires commonly used.

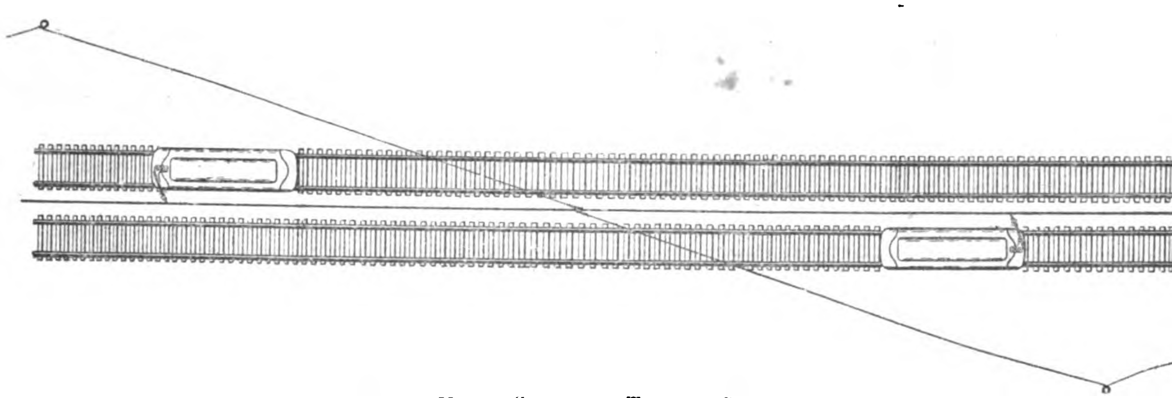


FIG. 1.—HENRY SYSTEM OF TROLLEY SUSPENSION.

In Figs. 1 and 2 is shown Mr. Henry's system of double track electric railway with the cars traveling in opposite directions and making contact against the sides of a single trolley wire which in this case is suspended between the double tracks from span wires at the usual height. The poles, instead of being located opposite each other, are staggered and occupy diagonal positions on opposite sides of the street, so that one-half of the number ordinarily used may be dispensed with and the strain on the remainder greatly reduced.

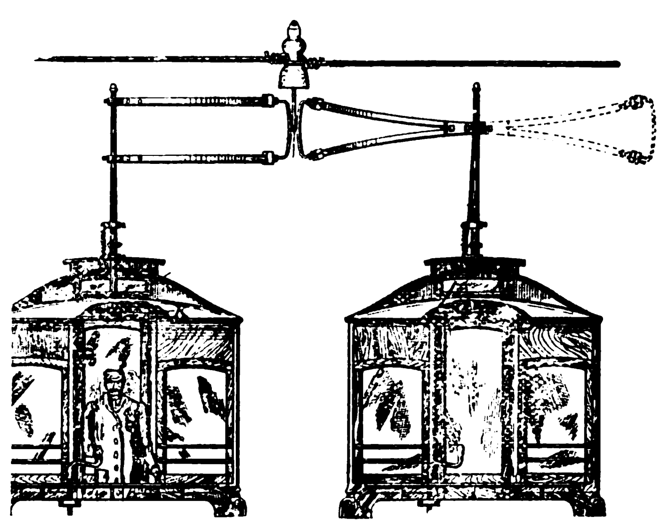


FIG. 2.—HENRY SIDE CONTACT TROLLEY SYSTEM.

In the construction shown the span wire strain is exerted in two directions on each pole, namely, laterally, and in a line parallel with the track, the latter component being comparatively small. With poles spaced, say, 200 feet apart, on opposite sides of a street, 50 feet between the curbs, the lateral strain on the pole is only one-half as much as the pull at right angles thereto (parallel with the track), and the lateral pull is a balanced one. The fact that but one trolley wire is used for both tracks is also a relief to the poles.

Fig. 2 shows a pair of trolleys mounted on cars on opposite tracks in engagement with the sides of the same trolley wire. It will be observed that the trolley is somewhat similar in

form to those used by the Siemens and Halske Company, in Europe and recently improved upon in this country, excepting that the Henry trolley is held laterally in a trailing position against the side of the wire. Further details of construction show the trolley to be under the control of the motorman from either end of the car.

ELECTRIC LIGHT AND POWER ON THE B. & O.

SOME very important additions are being made to the power and lighting plants along the line of the B. & O. Railroad. Mr. W. D. Young, superintendent of electrical construction, is giving his personal supervision to most of the work. The improvements in the Baltimore Belt Line power house are being rapidly pushed to completon. The foundaton is now being built for a 650 horse-power Greene-Corliss engine, direct coupled to a General Electric 500 kilowatt power generator. This is the fifth engine of this type to be erected in this powerhouse, and will add greatly to the power plant. It will be used in pulling the trains through the tunnel as well as in the general power work of the station. It will be remembered that in addition to furnishing the power for the Baltimore Belt Line tunnel motors, this plant also operates about 180 street cars of the Baltimore Traction Company and several small motors that are used by the railroad in switching cars at ferry slips. The total capacty of the power plant wil be 3,150 horse-power when the new engine is installed and it is expected that it will be in working order by the middle of January.

In the lighting plant, which is in the same station with the power plant, there is being erected a 250 horse-power Armington-Sims engine, belt coupled to one 150 kilowatt General Electric generator. Mr. Young is also replacing two 120 kilowatt alternating generators by two 150 kilowatt A. N. General Electric generators. The lighting plant now has a capacity of 1,150 horse-power and furnishes the current for the lights at Locust Point, all the Baltimore yards, Camden Station and numerous ferry slips and freight houses, besides lighting the tunnel and the Mount Royal passenger station. There has just been installed in this plant a Van Dresser automatic oiling system at a cost of about $3,600 by which all bearings on the engines and dynamos are automatically lubricated, saving the expense of six men.

In the boiler room there has been erected a C. W. Hunt coal and ash conveying apparatus which takes the coal from the dump to an overhead bin from which it is to lead immediately in front of the furnace doors, thus facilitating very greatly the work of the firemen. The buckets that handle the coal, are also arranged in such a way as to convey the ashes to the bin outside the boiler room where they are deposited automatically.

A repair shop has been fitted up in one end of the power house and Mr. Young has ordered and expects to receive in a few days the machinery necessary for the shop. This will consist of one field winding lathe, one engine lathe and drill press, several high speed lathes and the necessary testing machines, etc.

The electrical department of the B. & O. is now growing at a very rapid rate. The public has but a slight idea of the extent of the electrical plants. At Zanesville there is a 50-arc light plant which is to be increased to 75. It is contemplated to erect a lighting station at Philadelphia of 75-arc light capacity to light the stations, yards, piers, warehouses and platforms. The installation of this plant, if it is decided upon, will result in quite a saving to the company. At Benwood the lighting station will be made of sufficient power to light all the yards and shops at that point and also the company's property at Bellaire and Wheeling, a total of about 100 arc lights. The plant at Newark, O., which has a capacity of 30 arc lights, will be enlarged to 50. The improvements that are being made at Cumberland will require an extension at that point from 50 to 75 lights. At Garrett, Ind., the plant has been temporarily suspended, but it will be started up again soon. The Mount Clare plant, which has a capacity of 30 lights, will be discontinued and the power will come from the Baltimore plant. At Brunswick the extensive yard improvements will require 25 more arc lights making a total of 75 at that point. The other lighting plants of the road are at Washington, Grafton, West Va., Deer Park, Pittsburg and Chicago Junction.

FROM ONE OF THE COLLEGES.

"I cannot renew my subscription without expressing my appreciation of the excellence of your publication, and the many interesting features it possesses. Although I endeavor to read all current electrical literature, I find more pleasure in devouring the numerous good things contained in "The Electrical Engineer, than in perusing other periodicals. May your well-deserved success continue."

TRACTION TROUBLES IN TOLEDO.

A special dispatch from Toledo, O., of Dec. 14, says: There is a pretty fight on here between the first mortgage bondholders of the Toledo Electric Company on one side, and the Toledo Traction Company on the other, in which Eastern and Chicago capitalists are deeply interested. The move of the Traction Company to float nearly $3,000,000 of bonds in the East brought a representative of the first mortgage bondholders here to-day to press action for the appointment of a receiver for the Electric Company and an injunction restraining the Traction Company from using appliances of the General Electric Company here. A few weeks ago the stock in the Toledo Electric Company was sold to New York parties, who sold it to Ream & Hale, of Chicago, principal owners of the Traction Company. The bondholders were not consulted, and are now fighting to save the property back of the bonds. An injunction has already been granted, a motion for the appointment of a receiver filed, and now the bondholders, principally Boston men, are waiting for the court. The hearing will be held as quickly as it can be pressed.

RENO ELECTRIC STAIRS ON BROOKLYN BRIDGE.

The Reno traveling stairway has been given a trial at the New York end of the Brooklyn Bridge. The system has already been described frequently in the papers. Passengers stand on the incline in single file and are carried along and up as the flooring moves. The steel treads form an endless mat that assures firm footing. They stay there until left on the comb-shaped iron grating on the top platform. The grating is so fitted that nothing can catch, and no accident is possible. The handrail is a chain of steel links run by sprocket wheels and thickly covered with rubber. It moves uniformly with the endless footpath.

The experiment was run by an electric motor with the same electric current that was operating the bridge cars. Only a little increased current will be necessary to work the machinery when the entire system is in order. The capacity of the inclined elevator is put at 3,000 passengers an hour. The elevator was on exhibition at Coney Island last summer, and it is said carried 75,000 passengers without an accident.

THE BRIGHTON-ROTTINGDEAN ROAD, which operates across a short stretch of the deep water beach at Brighton, England, has, it is reported by cable, been washed away in a heavy gale. This probably refers to part of the trolley line, as the track was solidly laid.

ONE HUNDRED THOUSAND HORSES running wild, because electric cars and bicycles have cut them out of occupation, are proving a pest in Washington State, and the farmers are hoping for a hard winter to kill them off. This fall whole bands of them have been sold for one or two dollars apiece.

THE STREET RAILWAY REVIEW, of Chicago, beginning with January, 1897, will issue a foreign edition, the publication of which for the present will be quarterly. It will be given a wide circulation all over the world, and it is needless to add that it will be full of valuable and interesting matter. Messrs. Windsor & Kenfield have our best wishes for the success of their timely and deserving enterprise.

BROOKLYN, N. Y.—There was a serious blockade on the Brooklyn Bridge on Tuesday evening, Dec. 15, at the time when travel was the heaviest. Since the substitution of electric motors for steam locomotives the Bridge Trustees have obtained the propelling power from a station on Kent avenue, Brooklyn, which is supplied with four powerful engines. At 5:30 P. M. the crosshead of one of these broke, and the motive power for the bridge cars was materially reduced. The annual report of the Bridge Trustees, issued last week, speaks very favorably of the results with electric traction there. The traffic last year fell off a few hundred thousand passengers.

MINNEAPOLIS, MINN.—Work is proceeding satisfactorily on the massive new dam of the St. Anthony Falls Power Co. in the Mississippi River at Minneapolis. The Twin City Rapid Transit Company will utilize the power obtained from the new dam—estimated to be 10,000 horse-power—and transmit it electrically. The St. Anthony Company will install 10 horizontal turbines of 1,000 horse-power each; and these will be directly connected to a like number of alternating current generators by the Twin City Company, which leases the power at the water wheels. The electrically transmitted power will be used to operate the cars on the extensive electric railway system of St. Paul and Minneapolis by means of rotary transformers.

Society and Club Notes.

FEATURES OF THE GAS EXPOSITION.

Among the popularly interesting pieces at the Gas Exposition to be held in this city, in January, 1897, will be a tower of gas and glass and iron, which will stand in the center of the hall, designed and built by Louis Tiffany of New York, the creator of the celebrated Tiffany chapel shown at the World's Fair. As a show piece the tower will far surpass the chapel in brilliancy, as in size. It will be sixty feet in height, with a diameter of twenty feet at its base. The design of the tower is that of a cathedral altar. Superimposed, one upon the other, its graceful and multi-colored columns will rise to a pinnacle capped by a ball of fire. Over 3,000 open jets will glow and glisten from its countless prisms, and spaced here and there, row after row of incandescent gas lamps will add to the brilliancy of the effect. The tower will be made of pieces of glass of every conceivable color, blending and shading, from base to pinnacle, in all the hues of the rainbow. Just short of the apex a fountain of water will be playing, to be caught in a basin and disappear to reissue again several sections below. To accentuate the color effect, columns of steam will be driven up through the tower, cooling and condensing as they rise and forming thousands of water prisms on their sides.

The cost of the tower will probably exceed $35,000, and it is designed not merely for exhibition at this time, but as the contribution of the American gas interests to the Paris World's Fair of 1900. It will in itself constitute a powerful attraction, and, coming as it does, from almost the single artistic genius who, in the world of contemporary art, has made a distinct name and place for America, it will possess a unique interest.

AMERICAN FEDERATION OF LABOR.

At the Cincinnati convention of the American Federation of Labor, the Committee on Reorganization recommended that the National Association of Electrical Workers be granted affiliation and the co-operation of the American Federation of Labor in the work of organization, and the recommendation was concurred in.

Reports of Companies.

STATEMENT OF THE E. S. GREELEY & CO.

We have received from Messrs. E. S. Greeley and J. W. Sands, receivers of the E. S. Greeley & Co., the subjoined statement of the assets and liabilities of that concern:

ASSETS.

Store Stock—		
Inventory value	$59,735.36	
Estimated cash value		$44,801.00
Office and store furniture and fixtures	1,500.00	750.00
Shop stock, machinery, tools, etc.—		
Inventory value	21,253.05	
Estimated cash value		13,000.00
Laboratory stock, tools, etc.—		
Inventory value	5,835.22	
Estimated cash value		3,000.00
Accounts receivable.—		
Nominal value	96,700.84	
Estimated actual value		70,000.00
	$185,024.47	$131,551.00

LIABILITIES.

Accounts payable	$102,044.40
Bills payable	72,022.92
	$174,067.32

RECEIVER FOR THE SYRACUSE STORAGE BATTERY CO.

The Syracuse Storage Battery Company went into the hands of a receiver on Dec. 21 on the application of a majority of its directors. L. H. Groesbeck was appointed by Judge Hiscock, to whom the matter was presented, and will give a bond of $10,000. The directors all joined in the application. The papers show that the company, whose factory is in Phœnix, with the main office in Syracuse, has not sufficient capital at its command to continue operations. It is set forth that the liabilities amount to about $40,000, while the assets, consisting principally of patents, are assumed to be worth $30,000. The officers and directors are Riley V. Miller, president; Thomas Hooker, vice-president; Charles L. Pack, secretary and treasurer; Jacob Amos, H. L. Loomis and Ray B. Smith, directors.

The company operated under its own patents and also under a license from the Storage Battery Company of Philadelphia, Pa. It employed about thirty men.

IMPORTANT NEW WORK OF THE BROOKLYN EDISON CO.

Contracts have been signed for the sale to the Edison Electric Illuminating Co., of Brooklyn, of one of the most valuable shore front properties in Brooklyn. The price is placed at about $260,000. The property adjoins the piers of the Long Island Railroad Company at Sixty-sixth street. It is 260x1150 feet, giving a water frontage of 260 feet, with rights to 550 feet under water and 600 feet back of the bulkhead, taking half of the block from the water front to First avenue.

Mr. Peabody, the secretary and treasurer of the Edison company, says of this purchase and of the intention of the Edison company: "It is the intention of the Edison company of Brooklyn, as soon as the weather permits, to construct a steam plant for generating electricity of an aggregate capacity of 20,000 horse-power, which will probably be the most economically appointed plant of its kind in the world. There will be erected a one-story brick building 260x250 feet, which will have two rooms, a boiler and an engine room, the cost of which will be $300,000. This plant will be one of the best equipped stations in the country, and will put Brooklyn ahead of all other cities in the manufacture of electricity. The system will be underground, doing away with the overhead wires, as far as possible, and we expect to reach far into Long Island. We expect to be able to furnish current from this plant as far as Babylon on the south side of Long Island, Roslyn on the north and Garden City and Hempstead in the center. The whole system will be regulated by meter, both for lighting and power. Our system is perfectly insulated and the loss of power is almost nothing. With a large production of current the cost decreases and an average reduction to consumers will be the natural outcome."

Legal Notes.

MAYOR SWIFT'S VETO OF THE FOUR-CENT CHICAGO FARE ORDINANCE.

In his veto, on Dec. 22, of the four-cent street car fare ordinance, which had been sustained by the Chicago City Council by a vote of 20 to 47, Mayor Swift said that if he signed the measure he would place the city in the doubtful position of having consented to violate what the street car companies had accepted in good faith as a contract. These contracts stated that the fare should be five cents, and besides, the Mayor declared, there was no public demand for a cheaper street car fare.

A large number of street car employés whose wages were threatened with reduction, were in the galleries and wildly applauded every speech made against the ordinance, and when Mayor Swift read his measure constantly interrupted him with cheers.

RIGHT TO CUT DOWN TREES.

—The case of the Commonwealth of Philadelphia vs. Clark, affirmed by the Superior Court in an appeal from the decision of the Berks Court, is a case involving the right of telegraph and telephone companies cutting down trees for their lines. The defendants were employés of the American Telephone and Telegraph Company, and while stringing wires through the Schuylkill Valley they cut down a number of ornamental trees on the property of Mr. John Marshall, of the University of Pennsylvania, near Douglassville. It was contended that more trees were cut down than necessary, suit was brought, and the men were sentenced to pay a fine of $50 each, and in default to be committed for fifty days. Judge Endlich handed down an opinion, limiting the rights of such companies.

COMMERCIAL CABLE COMPANY.—The plan by which the Postal Company is brought into closer union with the Commercial has been carried through. It is provided that the plan will go into operation on January 1, 1897. The plan calls for the issue of $20,000,000 of bonds, $15,000,000, of which is to be paid for the plant, etc., of the Postal Telegraph-Cable Company and the $5,000,000 to be used hereafter for the extension of telegraph lines, etc. The bonds are 4 per cent., payable in gold, and a new departure has been made in the payment of interest quarterly.

Synopsis of Current Electrical Literature.

EDITED BY MAX OSTERBERG, E. E.

Central Stations:

SOUTHERN ELECTRIC LIGHT AND POWER CO., PHILADELPHIA, PA.—This station furnishes a considerable and important part of the city with arc lighting. The article explains the essential features.—"Elec. Eng'r.," Nov. 25, '96.

Dynamos and Motors:

BOOSTING WITH ALTERNATING CURRENTS.—By Alexander Russell, M. A. After briefly stating the way in which boosting circuits was first suggested, author takes up the following problems and deduces a mathematical, practical formula for each: 1. Boosting an open circuit. 2. Finding the ratio of the inductances of two coils by using a voltmeter only. 3. Finding resistances of the coils from the readings of the ammeter and voltmeter with alternating currents. 4. Finding the three inductances. 5. Formulæ for boosters. These show that as we increase the load, the ratio of the currents in the main and boosted circuits tends to a constant value.—Lond. "Elec.," Nov. 13, '96.

Electro-Chemistry:

TEMPERATURE CO-EFFICIENT OF THE HIBBERT ONE-VOLT STANDARD CELL.—In this cell the rise in value is very much less than 1-10,000 of a volt per degree, or taking the rise from 16 to 31 degs. C. (1.0004) of .0011 of a volt in 15 degs., it amounts to .0000733 of a volt per degree, or less than .01 per cent per degree.—Lond. "Elec.," Dec. 4, '96.

APPLIED ELECTRO-CHEMISTRY.—By James Swinburne. Lecture delivered before Society of Arts. After pointing out the dangers of blindly following formulæ for calculating e. m. f., developable in cells, author gives some calculations from the point of view of thermo dynamics; he then attacks the generally adopted theory of seat of e. m. f. in a cell, admitting, however, that in many cases his adverse views are due to differences in definition.—"Elec.," Nov. 4, '96.

TURBO ELECTRIC GENERATORS FOR ALKALI WORKS. Illustrations of a large machine used for the decomposition of salt into chlorine and caustic soda.—"Scient. Am. Suppl.," Nov. 21, '96.

Electric Railways:

HOW TO INCREASE THE WORKING EFFIENCY OF RAILWAY MOTORS.—By Wm. Baxter, Jr. It is shown in the article that to reduce the field cross-section so as to obtain higher velocity with larger effort is not a wise course to pursue, since increase is only obtained by an expenditure of an unreasonable amount of energy. For high speed motors a low magnetizing force should be used. The article is concluded with a table of current, horizontal effort, speed, power and efficiency.—"Elec. World," Nov. 7, '96.

Electrical Mining:

SIEMENS-HALSKE PROCESS IN OPERATION AT CHAPACA, WASH.—The Wyandotte Mining, Milling and Smelting Company are the first ones in this country to adopt the puric-potassic cyanide solution for the electrical precipitation of gold. In this process the use of zinc is entirely abandoned reducing the cost to a considerable degree.—"Elec. Journal," Dec. 1, '96.

Electro Therapeutics:

ELECTRICAL TREATMENT OF LOCOMOTOR ATAXIA. —By William Harvey King. Discussion of the treatment of one of the chronic diseases of the spine.—"Journ. of Electro-Therap.," Oct., '96.

THE TREATMENT OF RHEUMATISM BY ELECTRICITY.—By Chester G. Higbee, M. D. The galvanic current and electric massage are both frequently used with good results.—"Journ. of Electro-Therap.," Oct., '96.

THE THERAPEUTIC EFFECTS OF HIGH FREQUENCY CURRENTS.—By M. D'Arsonval. An apparatus, very similar to the Tesla oscillator was used and applied to patients suffering from diabetes with very favorable results; details of cases are described in L'Electricien and translated in Lond. "Elec. Rev.," Nov. 20, '96.

Lighting:

ON THE RESISTANCE OF THE ELECTRIC ARC.—By Julius Frith and Charles Rodgers, B. Sc. A carefully prepared dissertation with an investigation of the alternating current arc.—Lond. "Elec.," Nov. 13, '96.

Measurements:

MEASUREMENT OF TEMPERATURE; AN APPLICATION OF THE MEASUREMENT OF RESISTANCE.—By G. M. Clark, B. A. An outline of the elements of the subject of thermometry forms the first part of the paper; then the methods and principles applied for the measurement of resistance in order to determine measure of temperatures is made use of. The article consists of several sections, the first part (thermometry), being contained in Lond. "Elec.," Dec. 4, '96.

CALIBRATION OF A BRIDGE WIRE.—By W. M. Stine. An auxiliary wire method, which may easily be used by students.—"Elec. World," Nov. 7, '96.

AN INEXPENSIVE, ADJUSTABLE CONDENSER FOR HIGH POTENTIALS.—By Lucien I. Blake. A two-quart glass bottle filled partially with slightly acidulated water and containing an ordinary electric light carbon, which is connected to one terminal of the high potential circuit, is immersed in a tin jar 7 inches high, 8 inches diameter at top and 5 inches at bottom. This jar is placed on a metallic plate which forms the other terminal.—"Elec. World," Nov. 7, '96.

Miscellaneous:

THE ELECTRIC YACHT UTOPIAN.—Description of Mr. Astor's yacht. There are 408 storage cells, each having a rated capacity of 300 ampere hours. Two motors are used which may be run in series, multiple or separate. For various details, see "Elec. World," Nov. 7, '96.

UTILIZATION OF WASTE GASES FROM BLAST FURNACES.—In Hoerde, Germany, an interesting plant is installed in the large iron works. Gas from the blast furnaces, a kind of Dowson gas, is to be utilized in large gas engines coupled directly to a three-phase dynamo. Note in Lond. "Elec.," Nov. 13, '96, from Elektrotechn. Anz.

Power Transmission:

SMITH'S ELECTRO-MAGNETIC ELEVATOR.—The principle of the invention is the use of the solenoid. When the elevator is raised, the solenoid is drawn in, and the reverse action takes place when the car is lowered.—"West. Elec.," Dec. 19, '96.

Roentgen Rays:

NON-DEFLECTIBILITY OF CATHODE RAYS.—By Battelli and Gabrasso. In an article in Nuovo Cimento the authors claim to have discovered certain kinds of cathode ray which are not deflectible by a magnet. Note and editorial notice in Lond. "Elec.," Dec. 4, '96.

RECENT ROENTGEN RAY OBSERVATIONS.—By T. A. Edison. A list of chemical crystals fluorescing to the Röntgen ray in addition to those published in the "Elec. Eng'r.," March 25 and April 1, '96.—"Elec. Eng'r.," Nov. 18, 96.

X-RAYS.—By John Macintyre, M. B., C. M. C. F. S. Author, who is a throat and nose specialist, discusses the different conditions of the tubes, then refers favorably to the use of the camera and in his observations on the fluorescent screen he remarks that a coarse, thick screen has given him favorable results.—Lond. "Lancet," Nov. 7, '96.

THE EFFECT OF THE RAYS ON URINARY AND BILIARY CALCULI.—By Henry Morris, M. F. R. C. S. An illustrated article showing different kinds of calculi as they appear on the photographic plate after having been removed from the body.—Lond. "Lancet," Nov. 14, '96.

SOME EXPERIMENTS WITH ROENTGEN'S RADIATION.—By Prof. Threlfall and Mr. Pollock. Authors give results made with a simple tube which they claim can be made by any one familiar with elementary glass blowing.—Lond. "Elec. Rev.," Nov. 20, '96.

THE ESTIMATION OF THE SIZE AND SHAPE OF THE HEART BY THE ROENTGEN RAYS.—By H. Campbell Thomson, M. D. According to the author it is apparent that the outline of the heart and to some extent its movements can be seen by the aid of the Röntgen rays. He describes his method in "Lond. Lancet." Reprinted in "Elec. Rev.," Oct. 28, '96.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS, ISSUED DECEMBER 22, 1896.

Alarms and Signals:—

SPEED INDICATING ALARM. B. F. Card, Brooklyn, N. Y., 573,568. Filed Nov. 1, 1895.
Comprises a centrifugal device governed by the trolley, a bell with its knocker-support, and means for securing the adjustment of the support, so that the bell will ring at a predetermined speed of the car.

ELECTRIC SIGNALING APPARATUS. F. B. Herzog and S. S. Wheeler, New York, 573,591. Filed March 12, 1895.
The signal may be set to operate at a predetermined time.

ELECTRIC SIGNALING APPARATUS. F. B. Herzog and S. S. Wheeler, New York, 573,592. Filed Jan. 29, 1886.
Comprises a transmitter organized to transmit two separate variable signals at one transmission and at a receiving station an apparatus comprising two progressively moving elements, each controlled by a magnet, the first magnet being controlled by the first part of the transmission, and the second magnet by the second part.

ELECTRIC SIGNAL OPERATING DEVICE FOR RAILWAY TRAINS. G. F. and F. K. Singer, Mingo Junction, Ohio, 573,716. Filed May 22, 1896.
Means to announce to the engineer and conductor of a train when same has broken apart.

ELECTRIC FLOOR PUSH. H. C. Thompson, Boston, Mass, 573,723. Filed March 2, 1896.
Details of construction.

Batteries, Primary:—

ELECTRIC BATTERY. A. E. Stephenson, Chicago, Ill., 573,493. Filed June 29, 1896.
Adapted to supply current for bicycle lamps.

Distribution:—

SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRICAL ENERGY. C. M. Green, Cleveland, Ohio, 573,647. Filed May 23, 1896.
Comprises a dynamo provided with two or more separate sets of armature coils, separate working circuits connected between and included in series, with the separate groups of armature coils, and automatic cut-outs for short circuiting any one of the working circuits should it become broken.

Dynamos and Motors:—

ELECTRIC ENGINE. I. T. Dyer, Chicago, Ill., 573,581. Filed March 30, 1896.
Adapted for supplemental use on a steam locomotive.

Electro-Metallurgy:—

PROCESS OF AND MACHINE FOR MAGNETIC SEPARATION. R. H. Sanders and C. T. Thompson, Philadelphia, Pa., 573,485. Filed Aug. 10, 1892.
Details of construction.

ELECTRIC METAL SEPARATOR. H. H. Whitacre and A. C. Wolff, Wellsville, Ohio, 573,741. Filed Nov. 8, 1895.
A magnet having the faces of its opposite-placed poles recessed to form a conduit, and a mass of diamagnetic metal embraced between the opposite faces of the poles and extending longitudinally of the conduit and adapted to divide the current and deflect the material toward the poles.

Heating:—

ELECTRIC HEATER H. L. Taylor, Corning, N. Y., 573,629. Filed Aug. 6, 1896.
Comprises an electric conductor, an insulating enclosure within which the conductor is contained, a body of practically non-conducting liquid within the enclosure, and an outer heat-radiating body.

REGULATOR FOR ELECTRIC HEATERS. A. D. Lagrelle, Louvres, France, 573,670. Filed Jan. 29, 1894.
Means for heating water-closet seats and regulating the amount of current supplied.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. P. Hopkins, New York, 573,464. Filed June 13, 1894.
Focusing lamp adapted for lantern projection.

ELECTRIC ARC LAMP. E. H. A. H. R. Von Nollendorf, Vienna, Austria-Hungary, 573,526. Filed April 9, 1896.
Dispenses with the tubular upper part containing feed mechanism common to arc lamps.

ELECTRIC ARC LAMP. P. F. H. Queisser, Charlottenburg, Germany, 573,617. Filed Jan. 24, 1896.
Feed mechanism for alternating arc lamps.

ELECTRIC LIGHT SUPPORT. E. J. Fulghum, Traverse City, Mich., 573,817. Filed June 24, 1895.
Details of incandescent lamp support.

ELECTRIC ARC LAMP. J. A. Mosher, Chicago, Ill., 573,830. Filed Oct. 22, 1896.
Feed mechanism for lamps of the "gravity-feed" type.

Miscellaneous:

ELEVATOR. C. R. Pratt, New York, 573,531. Filed June 29, 1891.
Comprises current regulator and circuit reverser on the elevator car, a hand wheel and a cable connecting it with and to positively operate the current regulator and circuit reverser.

COMBINED TOILET PAPER HOLDER AND ADVERTISING DEVICE. W. Fisher, Chicago, Ill., 573,586. Filed Oct. 28, 1895.
Details of construction.

COMBINED LIGHTNING AND WATER CONDUCTOR. L. Adams, Buffalo, N. Y., 573,750. Filed Sept. 30, 1896.
Details of construction.

ELEVATOR MECHANISM. J. H. Clark, Boston, Mass., 573,809. Filed July 28, 1890.
Details of construction.

ELECTRIC ELEVATOR. P. W. Leffler, Chicago, Ill., 573,820. Filed Aug. 19, 1895.
The combination with the car provided with an armature, of combined magnetic-field producing devices and guide extending along the line of travel, for co-operation with the armature and a car, to propel and guide it.

Railways and Appliances:—

APPARATUS FOR PREVENTING COLLISIONS ON ELECTRIC RAILWAYS. B. C. Tilghman, Jr., Philadelphia, Pa., 573,496. Filed April 13, 1894.
The combination with crossing tracks of means under the control of a train moving along one track for temporarily cutting the electricity off from a portion of conductor along the track.

TROLLEY POLE GOVERNOR. V. T. Lynch, Chicago, Ill., 573,517. Filed March 4, 1896.
Means to keep the trolley rope taut while permitting the rise and fall of the pole as the car travels.

TROLLEY ADJUSTING AND REGULATING DEVICE. C. F. Randall, Denver, Colo., 573,535 Filed March 31, 1896.
Details of construction.

AUTOMATIC SYSTEM OF DISTRIBUTION AND CONTROL FOR ELECTRIC RAILWAYS, ETC. W. H. Cooley, Brockport, N. Y., 573,645. Filed Aug. 3, 1895.
Consists in supplying the current to the car over a series of working conductors, in such a way that a working conductor to the rear as well as another one in advance of the motor-car is automatically cut out.

ELECTRIC RAILWAY P. W. Leffler, Chicago, Ill., 573,819. Filed Aug. 12, 1895.
Comprises field magnets extending along the line of travel, a series of co-operating magnetic sections arranged longitudinally of the car, and a controller on the car for rendering the magnetic sections operative or inoperative, cumulatively, in pairs, one on each side of the center of the armature.

ELECTRIC RAILWAY, ETC. P. W. Leffler, Chicago, Ill., 573,821. Filed Sept. 26, 1895.
The combination with a car of field magnets extending along the line of travel, and a rotary magnetic body, carried by the car-body, having spirally arranged pole pieces subject to the action of the field.

ELECTRIC RAILWAY, ETC. P. W. Leffler, Chicago, Ill., 573,822. Filed March 11, 1896.
Means for controlling the field sections.

MOTOR CAR TRUCK. P. W. Leffler, Chicago, Ill., 573,823. Filed March 21, 1896.
In combination with a sectional truck, a sectional armature, carried, one section on each of the truck sections, and a common universal joint applied to couple together the truck sections and the armature sections.

Regulation:—

AUTOMATIC SPEED REGULATOR FOR ELECTROMOTORS. L. Denayrouze, Paris, France, 573,767. Filed Nov. 26, 1895.
Comprises a contact disk mounted on the motor-shaft and connected with one brush of the commutator, a disk mounted on, and insulated from, the motor-shaft and provided with a contact, electric connection of the disk with the generator, and a contact having a flexible connection with the shaft and adapted to engage the former contact.

Switches, Cut-Outs, Etc:—

ELECTRICAL RESISTANCE DEVICE. D. C. Voss, Malden, Mass., 573,558. Filed March 16, 1896.
Composed of carbonized fibrous material, a metallic oxid, and a binder.

ELECTRIC SWITCH. W. and H. Boardman, Lancaster, Pa., 573,807. Filed March 28, 1896.
Push button switch.

Telegraphs:—

ELECTRICAL SWITCHING APPARATUS. F. W. Jones, New York, 573,601. Filed Oct. 15, 1896.
Employs a spring jack, two or more flexible cords, a plug for each cord, a take-up device for each cord and means for locking or holding a cord against the action of the take-up device.

Telephones:—

TELEPHONE EXCHANGE SYSTEM. W. W. Dean, St. Louis, Mo., 573,575. Filed June 11, 1896.
The combination with metallic circuit and grounded telephone-lines, of a common battery, and an additional battery in circuit with the grounded lines and adapted to supply additional electromotive force to the grounded lines, whereby the standard current may be maintained upon both metallic circuit and grounded lines.

COMMON BATTERY TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 573,576. Filed Sept. 19, 1896.
A local transmitter circuit comprising an induction coil and a microphone included in circuit with the induction coil, and a battery adapted to direct current through the primary and secondary helices of the induction coil in series, the primary and secondary helices being also connected in series in the path of the voice-currents.

ELECTRICAL CONNECTING CORD. C. H. McEvoy, Lowell, Mass., 573,612. Filed Feb. 24, 1896.
Comprises a conducting core, a conducting tip in electrical connection with the core, a non-conducting supporting-cord and a link, arranged to surround the tip and to receive the supporting cord.

TELEPHONE ATTACHMENT. W. O. Christopher, Hillsborough, Texas, 573,441. Filed Aug. 29, 1895.
A device which will support the weight of the telephone receiver on the switch lever whether the receiver be hung on the hooks of the lever or dropped.

FUNNY NEWS FOR AMERICAN INCANDESCENT LAMP MAKERS.

A dispatch from Washington says: "As a matter of curiosity United States Consul Morris at Ghent reports to the State Department that the most expensive product in the world is the charcoal thread employed for incandescent lamps. It is for the most part manufactured at Paris and comes from the hands of an artist who desires his name to remain unknown in order to better protect the secret of manufacture. It is by the gramme that this product is sold at wholesale. In reducing its price to the basis of pounds, it is easily found that the filaments for lamps of twenty candles are worth $8,000 per pound, and that for lamps of thirty candles they are worth $12,000 per pound. The former have a diameter of twenty-

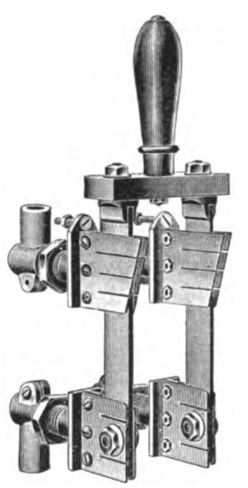
thousandths of one millimeter, and the latter four and one-half thousandths of a millimeter. The filaments for lamps of three candles are so light that it would require nearly 1,500,-000 of them to weigh a pound. As the length of each of them is ten centimeters, their total length would be 187 miles." The name of the "unknown artist" is "Legion." He lives at several places.

Trade Notes and Novelties

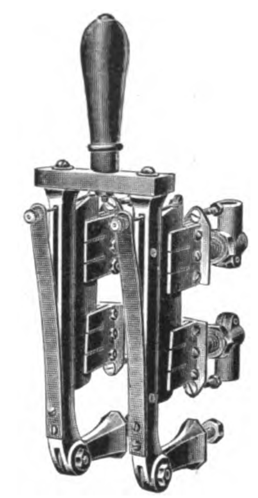
AND MECHANICAL DEPARTMENT.

THE WESTERN ELECTRIC KNIFE SWITCH.

THE demand for high grade knife switches has brought upon the market designs of various makers. The most recent are the type "E" and type "Q" manufactured by the Western Electric Company, Chicago. The contacts of these switches are all rolled tempered copper and the greatest care in construction and design has been observed in order that the switches would carry their rated capacity in amperes



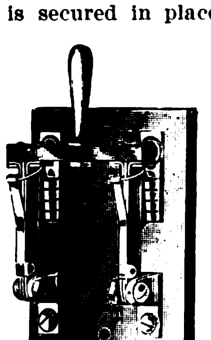
TYPE E FOR SWITCHBOARDS.



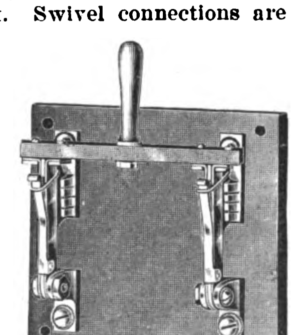
TYPE Q FOR SWITCHBOARDS.

without showing any heating of the parts. In placing and fastening the jaws in position they are not soldered, but bolted to the metal plates or lugs as can be seen from the illustration. By this method the temper of the jaws is in no way injured and they will always grasp the blade of the switch with an equal and unvarying contact which will not deteriorate with time. The hinge contact is made in the same way and the bolt which passes through the hinge is provided with a lock nut, preventing any liability of loosening or poor contact at this point. The blades are of drawn copper, hand finished.

The base is extended for connections on back of board and is secured in place by a lock nut. Swivel connections are



TYPE Q WITH SLATE BASE FOR 110 VOLTS.



TYPE Q WITH SLATE BASE FOR 500 VOLTS.

provided which will admit of the circuit wires being brought into the switch from any direction. The switches are all made to gauge and any repair part can be obtained and a damaged part replaced in a few moments.

The type "E" is for station and switchboard work, being of the regular jaw pattern. The type "Q" is essentially the same as type "E" with the addition of a quick break spring and is especially approved by the underwriters for an entrance or service switch for motor work, constant potential arc, or incandescent lighting.

The cuts of quick break switches mounted on slate bases are shown, one for a pressure up to 110 volts, the other for a pressure up to 500 volts.

An illustrated circular and price list on "E" and "Q" switches has been issued by the Western Electric Company and a number of sizes are carried in stock.

THE PHOENIX CARBON MFG. COMPANY DOUBLING ITS PLANT.

The entire city block just north of the present plant of the Phœnix Carbon Manufacturing Company of St. Louis, Mo., has been purchased by that company and the establishment in the very near future will be greatly enlarged by the addition of more special carbon machinery and the erection of new carbon furnaces and ovens.

This move is of especial interest to the electrical and allied industries, as it is an indication of the growing improvement of one of the most important carbon factories, entirely independent of the association, which is recognized as the carbon trust or combination, known to exist. The Phœnix Carbon Manufacturing Company has been established between two and three years and its organization by Mr. S. G. Booker was done with the strong belief that, owing to the condition of the carbon trade, there was an opportunity in view of the carbon-making alliance for such an independent company. Col. Booker, because of his specific knowledge of carbon, its characteristics, and application for electrical uses, combined with his popularity in the electrical field, was peculiarly fitted for the management.

The company will continue the production of staple forms of carbons, making also in greater quantities the battery carbons for which it has gained reputation, and also carbon specialties for telephone, motor brushes, and the multitudinous forms in which carbon is used.

THE PURITAN 100-HOUR ALTERNATING ENCLOSED ARC LAMP.

Through a perversity of the types the Puritan enclosed arc lamp for alternating circuits mentioned in our last issue was credited with a run of only 10 hours. It goes without saying that 100 hours was intended. Ten-hour lamps don't go for much nowadays, it would appear.

CUTLER-HAMMER MFG. CO.

Mr. E. W. Hammer, late secretary of the Cutler-Hammer Manufacturing Company, Chicago, has sold his interest in the above company to Horace S. Smith and Harry H. Cutler. Mr. Smith is well known to the mechanical world as the late general manager and vice-president of the Illinois Steel Company, and Mr. Cutler needs no introduction to the electrical trade.

The company has been reorganized and put on a sound financial basis, with a largely increased capital. Their factory is being enlarged to take care of the rapidly growing business, and to better enable them to keep up their reputation for prompt shipments and high class work.

GROWTH OF THE STANLEY ELECTRIC CO.

The Stanley Electric Company held a special meeting at Pittsfield, Mass., on Dec. 20, and voted to increase the capital stock of the concern from $300,000 to $500,000. This step has been rendered necessary by the constantly increasing business of the company, and the growing magnitude of the plants it has to instal. It is expected that all of the increased stock will be taken by stockholders and that it will be taken up by February 15. The company expects to double its business by the end of the next year.

LEFFEL WHEELS AT NIAGARA.

The new hydraulic power company at Niagara Falls have now in successful operation their new power plant, consisting of four of the Leffel celebrated Niagara type of turbines, each of about 2,200 horse-power capacity, or giving in all some 9,000 horse-power. These turbines drive eight generators of something over 1,000 horse-power each; two generators being connected directly to the shaft of each wheel, one being placed on each side. The same company have four other of the Leffel Niagara turbines, using in all eight of that style of wheel. The plant was recently illustrated and described in The Electrical Engineer.

MR. G. G. LUTHY, Peoria, Ill., made a short business trip to Chicago recently and was as usual hustling for business in the interest of the Royal Electric Company.

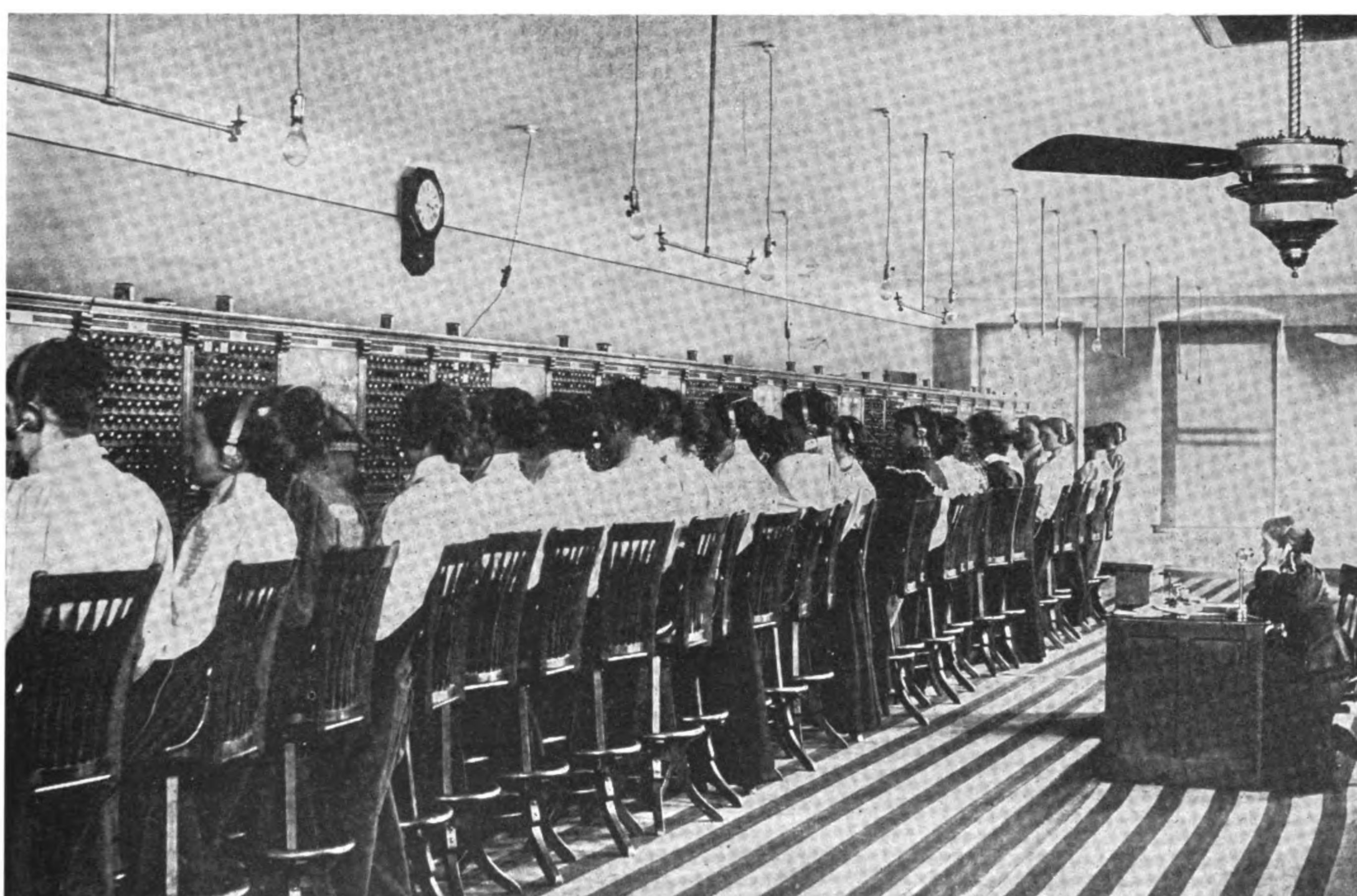
THE "INDEPENDENT" TELEPHONE EXCHANGE AT GRAND RAPIDS, MICH.

ONE of the largest and most progressive of the telephone exchanges started in opposition to the pre-existing Bell interests is that at Grand Rapids, Mich. The exchange is carried on by the Citizens' Telephone Co., who until recently had provided for 1,800 subscribers, but who now have been putting in additional capacity, bringing the switchboard provision up to 3,000. When the exchange was started, each operator was given 100 drops to look after. The exchange is so busy, however, that this has been found too much, and the new board has only 75 drops to each section. The Citizens' company procured an ordinance from the council, built its exchange, and on July 1, this year, began business. The ordinance fixed the rates at $24 and $36 for residences and business places respectively. The company cut this to $20 and $30 in consideration of subscribers signing a three-year contract. The new company started with 1,200 subscribers and has since increased to 1,750. Before the competition came in the old Michigan Bell company had 1,600 subscribers. The list is now about 1,000, it is stated, and of these about 500 use both systems.

When the reduced rates went into effect the old company did not directly cut the rates to meet the competition, but accomplished the same thing by giving rebates. Since July the old company had shown no particular sign of activity, but ever since the construction on the new exchange began it has been busily engaged improving the service and putting in the latest appliances. It is now ready to fight, and on Jan. 1 new subscribers or old subscribers returning to the fold will be given free service for three months. What will happen after that time has not yet developed.

In addition to the new company at Grand Rapids, local companies have been established at Muskegon, Holland, South Haven, Allegan, Lansing, Hastings and at other points, and during the summer and fall these towns have all been connected with Grand Rapids, thus affording a State service, but the lack of an independent exchange in Detroit will make that city inaccessible for practical purposes to the non-Bell subscribers. It is said that the completion of the new Home Company's system in Detroit will change this condition of affairs.

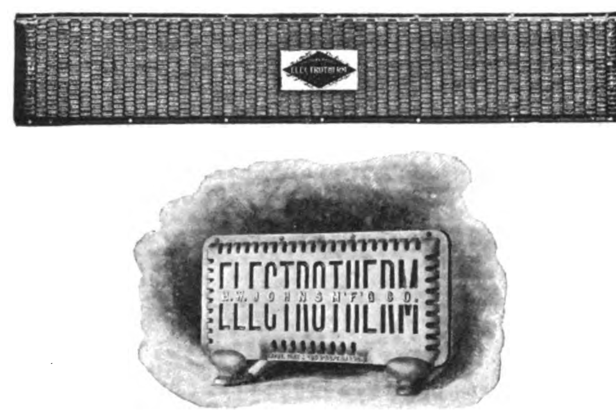
The apparatus for the Grand Rapids Citizens' Telephone Co. has been built by the American Electric Telephone Co., of Kokomo, Ind., the details of whose apparatus have already been illustrated in these pages. The officers of the Citizens' Company are E. B. Fisher, president; C. F. Rood, vice-president; A. S. Musselman, secretary; J. M. Barnett, treasurer; J. B. Ware, manager. Their system is one of the largest and best managed of those which have sprung into existence since the expiration of the Bell patents and the effort to extinguish the Berliner.



AMERICAN ELECTRIC TELEPHONE CO.'S APPARATUS, CENTRAL EXCHANGE, CITIZENS' TELEPHONE CO., GRAND RAPIDS, MICH.

"H. W. J." ELECTRIC CAR HEATERS.

OUR illustrations show two of the forms of the "H. W. J." car heater which are in extensive use on various electric railroads. They are of a panel heater 50 inches long, and of an upright heater for cars having cross seats. The method of constructing these two types of heaters is as follows: The resistance wire, wound and insulated with asbestos, is woven into a cloth, which is saturated with a water-proofing compound and attached to an asbestos backing, similarly prepared, the whole thing being subjected to a baking at a high temperature. The heater thus formed is, in the case of the panel



H. W. JOHNS ELECTRIC CAR HEATERS.

heaters, inclosed in a punched steel casing, the finished heater being but seven-eighths of an inch thick, 9 inches wide and 50 inches long, and weighing sixteen and a half pounds. The upright heater has a cast iron casing and weighs 17 pounds. This heater is 18 inches long, 10½ inches high and 2¼ inches thick.

The use of "H. W. J." heaters introduces radical improvements in the methods of heating street cars. As the panel heaters are very thin, when placed on the faces of the panels below the seats, they do not take up space otherwise available or interfere with the movements of the passengers. No cutting of the woodwork is required for their installation. It has heretofore been customary to place a few electric heaters in a car and to operate them at a high temperature, to the discomfort frequently of the passengers nearest them, and at a risk of scorching clothing and setting fire to the car. In the "H. W. J." system, it is recommended to install as many heaters as the available space will permit, with the view, by so doing, of being able to operate the heater at moderate temperatures individually and to distribute the warmth more uniformly throughout the car. The effect of heating a car by this method compared with a car heated by a smaller number of heaters is immediately apparent. The large radiating surfaces furnished by the H. W. J. heaters also insure a greater economy in the uniform distribution of the heat to the passengers, and a longer life for the heaters, as under normal conditions no part of the heaters is subjected to such an excessive temperature as to lead to deterioration from overheating, while rusting-out and crystallization through vibration are also promoted by the compact, and practically air-tight envelope.

In the weaving of the heater, the resistance wire is separated into two sections, known as the upper and lower. In regulating the temperature, to obtain the least amount of heat, the upper sections of all the heaters are connected in series. For a moderate or medium temperature, the lower sections of all the heaters are connected in series, and to obtain the greatest heating effect, the upper and lower sections are connected in multiple. These combinations are effected by the improved "H. W. J." regulating knife switch, which is simple and durable in construction and designed to endure the rough treatment to which devices on a trolley car are liable.

ADVERTISERS' HINTS.

THE CENTRAL ELECTRIC COMPANY announce they are ready to "wade" in for 1897 business and their friends may be sure they will not wade in vain.

THE CROCKER-WHEELER ELECTRIC COMPANY advertise a complete line of dynamos and motors and all things pertaining thereto.

G. A. FREI & CO., 17 Bromfield street, Boston, Mass., show several styles of Crookes tubes in their "ad" this issue. A new catalogue of everything needed in X-ray work may be procured on application.

THE BERLIN IRON BRIDGE COMPANY illustrate a roof designed and built by them for the Norwalk (Conn.) and South Norwalk Electric Light Company. The dynamos are moved by a traveling crane of 4,000 pounds capacity, supported by the roof trusses.

THE WABASH RAILROAD COMPANY call attention to their excellent train service to the West from New York and Boston. Tickets are sold with ten days' stop-over privilege at the Falls.

THE AMERICAN ELECTRIC HEATING CORPORATION in order to enable dealers to test the value of electric heating goods as money-makers, have made up an assortment of good sellers and send free with each assortment a three-foot oak case in which to display them.

WESTERN NOTES.

ROBINSON & MORSE, Chicago sales agents of the Buckeye Engine Company, are pushing hard for a share of the engine trade in the electric light, street railway, and power field in that territory, and have recently closed the following contracts: Calumet Electric Street Railway Company, Chicago, 1,000 horse-power cross compound; Lincoln Park, Chicago City Lighting Station, two 200 horse-power tandem; Moline, Ill., Electric Light and Power Company, 600 horse-power cross compound; Western Electric Company's plant, Chicago, 200 horse-power cross compound; Western Light and Power Company, Chicago, 600 horse-power cross compound. Mr. A. M. Morse, who until recently looked after the interests of the Buckeye Company in St. Louis, has now joined forces with Mr. Robinson, the Chicago representative of the concern, and both are located at 1249 Marquette Building.

MR. R. L. McOUAT, of Varney & McOuat, Indianapolis, was a recent visitor to Chicago, where he not only attended strictly to business, but also was able to combine a little pleasure at the same time.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, Mo., have issued a large chromo-lithographic calendar for 1897, which will find many admirers. The picture represents a little girl in dressing robe who has climbed up on a chair in order to have a confidential talk over the telephone with Santa Claus. The idea is carried out with great cleverness and delicacy of treatment.

MR. CARL KAMMEYER, who was formerly connected with The Electrical Engineer, as its Western representative, has now joined the staff of "Farm Machinery" in St. Louis, a city where he is well known as an old resident. Our contemporary is to be congratulated upon a very valuable acquisition.

THE ELECTRIC APPLIANCE COMPANY report a daily increase in their "Armorite" sales, and are more and more pleased by the way the trade seems to appreciate their efforts to give them a superior article in the line of an iron armored conduit. The demand increases.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, who are Western Agents for "Mac" Tape, report a large demand for this standard article, which they carry in stock. Upon test and comparison, the "Mac" Tape will show, it is asserted, a larger proportion of good india rubber in its composition than any other tape. The adhesive and insulating qualities are very high.

NEW YORK NOTES.

MR. A. O. SCHOONMAKER, 158 William street, New York, has opened a Western branch at 1563 the Monadnock, Chicago, where he carries a full line of electrical mica, Mr. John Childs having charge of the business in that territory.

HUEBEL & MANGER, Brooklyn, N. Y., have reason to congratulate themselves upon the amount of business they are doing; the last two months being the best they have ever had. Their plant is being driven to its utmost capacity, and they are turning out bells and push buttons in such quantities as to make one wonder where they are all going to be used.

THE ASHCROFT MANUFACTURING COMPANY, of 111 Liberty street, New York, have just issued their new catalogue, a copy of which they have favored us with. It is bound in cloth, admirably illustrated and full of information. Among the noteworthy specialties included are the Edson pressure recording and alarm gauge, the Tabor steam engine indicator and the Moscrop speed recorder. It is a useful buying guide for central station and railway managers.

ALBRIGHT & CO., of New York City, are to establish chemical works at Niagara Falls and use the power there.

THOS. J. FAY & ASSOCIATES, 143 Liberty street, New York, New York agents and general exporters for the Crocker-Wheeler Electric Company, have been awarded the contract for the lighting plant for Hull & Co., of Poughkeepsie, N. Y. The dynamo will be one of the latest perfected multipolar Crocker-Wheeler machines of 600 lights capacity.

MR. JOS. F. O'DAY, who has been for some two or three years in charge of the outside construction work for the C & C Company in New York, has joined the forces of Thos. J. Fay & Associates, electrical engineers and contractors, 143 Liberty street, New York.

MR. WALTER J. JONES, formerly superintendent for the Suburban Electric Light Company, of Scranton, Pa., for the past four years, has been appointed electrical superintendent of the Hackensack (N. J.) Gas and Electric Company.

NEW ENGLAND NOTES.

THE AMERICAN ELECTRICAL WORKS are well known to "have a pudding," and this year they have sent their friends a very pretty little fac-simile of it accompanied by good wishes. They have also sent out a tasteful calendar with a colored representation of their Philadelphia mills.

THE MOSSBERG & GRANVILLE MANUFACTURING COMPANY, Providence, R. I., a notice of whose incorporation and removal to new and larger quarters appeared in our last week's issue, are manufacturing a line of presses which are particularly adapted to the rapid production of sheet metal stampings and of drop forgings for electrical use. Commutator bars and segments, brush holders, incandescent lamp sockets, plain and ornamental stampings for electrical work can be rapidly and economically produced by their means. Among their specialties is a press which will punch armature sheets at one operation, a great saving over the old-fashioned ratchet dial feeding in common use. This firm may well be called a headquarters for presses.

Department News Items will be found in advertising pages.

5721. Sheet 1.	WIRING SECTION PLATE FOR RANGE UP TO 3 VOLTS DROP, 20 AMP., 150 FEET.	A.

The wiring section plate, shown on 5721, Sheet 2, will solve any problem of wiring within the range of 3 volts drop, 20 amperes and 150 feet distance. The distance given being one-half of the electrical distance, and the formulæ is d^2 (circular mils), equals current (*C*), multiplied by distance to point of consumption (*D*), multiplied by the constant 21.21, and divided by volts drop (*V*), or

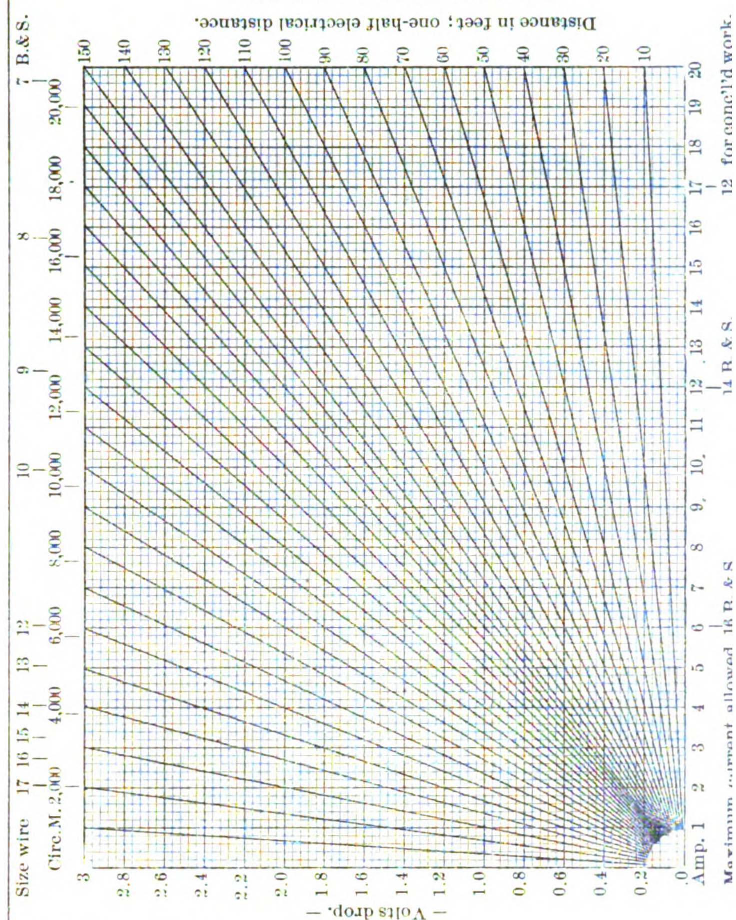
$$d^2 = \frac{C \times D \times 21.21}{V}.$$

The method of using this wiring section is as follows: Given any three quantities in a wiring problem, to find the fourth. For instance: 8 amperes, 2 volts drop, 124 feet, to find proper size of wire. Find the intersection of 8-ampere vertical line from "ampere" line with 2-volt drop horizontal line from "volts drop" line, and then follow the diagonal line until the horizontal line from 124 feet is reached, which will be on the vertical line from No. 10 wire on the top scale of wire in the B. & S. gauge or circular mils, which is the quantity sought.

The line of sizes of wire under the "ampere" line is the capacities allowed by the underwriters for B. & S. wires when used in concealed work. The use of this is to provide against overloading the wires, which can occur with large drops at short distances. For instance, suppose it were given to carry 12 amperes with 1.25 volts drop, 18 feet; it will be noticed that we have passed in following the diagonal backward to a wire smaller than No. 14 for 12 amperes, which is too small to meet the underwriters' requirements of 12 amperes for No. 14 wire in concealed work, and, consequently, No. 14 wire is the smallest wire that can be used.

If any three quantities are known the others can be found. For instance, we have a No. 9 B. & S. wire and want to reach a consumption circuit of 10 amperes, 110 feet away, and the drop on this load is required. Find the intersection of the two adjacent quantities (that are on opposite sides of the diagonals), such as No. 9 wire with 110 feet, and follow between the diagonal lines down until the line from 10 amperes is reached, when it will be found that 1.8 volts also intersects at this point, and is the quantity sought.

5721. Sheet 2.	WIRING SECTION PLATE FOR RANGE UP TO 3 VOLTS DROP, 20 AMP., 150 FEET.	A.

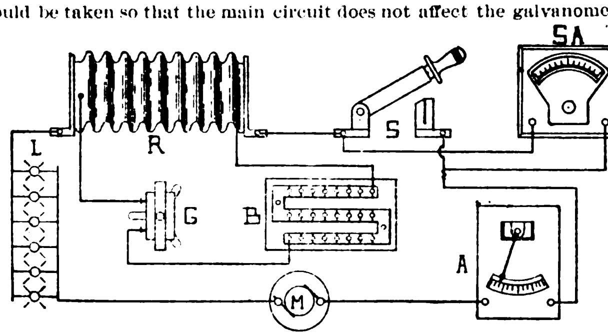


5950 Sheet 1.	POWER REQUIRED FOR THE ELECTROLYTIC SEPARATION OF VARIOUS METALS.	A.

Metal.	Designation of the Electrolyte.	Heat of combination taken in relation to 1 kgr. of the metal.	Energy required for the deposition of 1 kilogr. of the metal.		Weight of the metal deposited per h.-p. per hour.	
		Cal.	Kilogr.-met.	H.-P. hr.	Kilog.	Lbs.
Copper.	Sulphate of copper	886	375,700	1.39	0.719	1.58
"	Chloride of copper	900	419,800	1.39	0.645	1.42
Silver.	Double cyanide of silver and potassium	33	14,220	0.05	18.900	41.66
"	Nitrite of silver dissolved in ammonia	81	34,340	0.13	7.700	16.97
Gold.	Chloride of gold (with cyanide of potassium)	139	58,700	0.22	4.600	10.14
Nickel.	Double sulphate of nickel and ammonium	1,484	629,400	2.33	0.429	.945
"	Double chloride of nickel and ammonium	1,586	671,700	2.49	0.402	.886
Tin.	Protochloride of tin	688	291,400	1.08	0.926	2.041
Lead.	Acetate of lead	320	136,000	0.51	1.985	4.375
"	Nitrite of lead	332	141,000	0.52	1.915	4.221
Zinc.	Double oxalate of zinc and ammonium	740	314,400	1.16	0.858	1.891
"	Double cyanide of zinc and potassium	896	379,800	1.41	0.711	1.567
Mercury.	Chloride of mercury	298	126,800	0.47	2.129	1.692
Aluminum.	Chloride of aluminum and ammon.	8,680	3,679,700	13.60	0.073	.161
Magnesium.	Chloride of magnesium and ammonium	7,665	3,249,600	12.00	0.083	.183
Potassium.	Sulphate of potassium	2,512	1,065,000	3.95	0.253	.557
"	Chloride of potassium	2,584	1,094,000	4.05	0.247	.544
Sodium.	Sulphate of sodium	4,063	1,725,500	6.39	0.156	.344
"	Chloride of sodium	4,183	1,773,200	6.57	0.152	.335
Antimony.	Trichloride of antimony	749	317,200	1.17	0.851	1.876
Iron.	Double chloride iron and ammon.	1,785	754,400	2.79	0.358	.789
"	Double oxalate of iron and ammon.	584	247,300	0.92	1.091	2.405
Platinum.	Chloride of platinum (with cyanide of K.)	209	88,616	0.33	3.050	6.722
Hydrogen.	Water acidulated with sulphur. ac.	34,500	14,626,800	54.18	0.0184	.040

517. Sheet 4.	LABORATORY METHOD OF CALIBRATING AMPEREMETERS.	B.

The diagram shows the method used when the standard amperemeter does not read high enough for full range of amperemeter to be calibrated. SA is the standard amperemeter; R is German silver shunt, unknown resistance, with ample carrying capacity to carry maximum current required, without heating; G is a tangent galvanometer, preferably Thomson or d'Arsonval; B, variable resistance box; M, source of current; L, variable resistance or lamp bank; S, switch to short-circuit standard amperemeter; A, amperemeter to be calibrated. Suppose SA reads to 25 amperes. A is to be calibrated to 200 amperes. Before passing the current through the circuits the galvanometer should be adjusted so that the spot of light reflected from galvanometer mirror is at zero on the galvanometer scale. Care should be taken so that the main circuit does not affect the galvanometer;

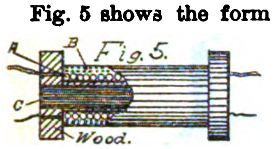


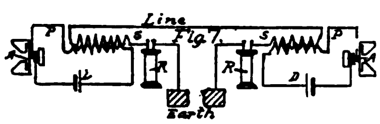
then allow 25 amperes to pass with switch that shunts SA open. The resistance can then be varied in the rheostat, B, until the deflection on the scale is some convenient multiple of the reading of SA. Say, take 5 divisions per ampere; then with 25 amperes, the resistance of B should be adjusted so that there will be 125 deflections on the galvanometer scale, and if the total division of scale is 1,000, we can close switch S and vary the current for the proper readings required on the amperemeter A, within the range of 0 to 200 amperes. There are corrections that will have to be applied to bring the work closer than this, such as allowing for change of resistance due to heating of the shunt, correction of galvanometer deflections which are not strictly tangential, and any error that may be in the standard can be corrected for in the deflections of the galvanometer when it is first set up.

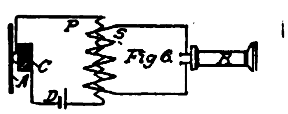
5932. Sheet 3. TELEPHONE CONNECTIONS. B.

The best conditions under which the transmitter can operate, as shown in Sheet 2, is when the current is large, and the resistance of the transmitter circuit low. This is not permissiable with a long distance circuit, or when speaking with receivers in the same circuit, as the transmitter will not, in this case, work under maximum conditions. All telephone circuits are greatly improved in their operation, if the battery current passes through the transmitter and also through an induction coil.

Fig. 5 shows the form of induction coil generally used in telephone work.







The primary (shown at A, Fig. 5) with a few turns is connected, as in Fig. 6, in series with the battery D and transmitter C. It consists of about 180 turns No. 23 B. W. G. copper wire, and measuring .5 of an ohms. This is wound on a hollow spool, and over these turns and insulated from them, is wound the fine wire secondary B. There are 4,000 turns No. 28 B. W. G. on this secondary coil measuring 250 ohms. A core of fine iron wires C is passed through the hollow centre.

Fig. 7 shows a complete set of receivers and transmitters with induction coils, connected up without signalling arrangements. A, transmitter; D, battery; R, receiver; P, primary coil; and S, secondary coil.

5831 Sheet 1. METHODS FOR DETERMINING DATA FOR DYNAMO REGULATORS. B.

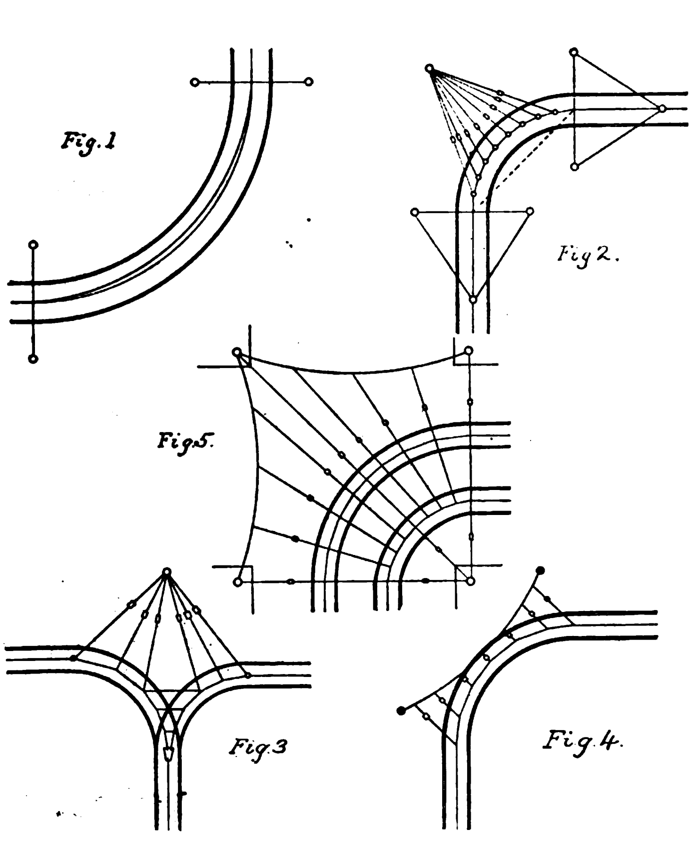
There exists no relation between the fixed resistance of the field of the different types of dynamos and the resistance required in the regulator. In order to control the machine under all circumstances, the regulator, to be properly designed, should have sufficient variable resistance to bring the voltage down on the machine when on open circuit, when the fields are excited from a voltage equal to the maximum voltage of the machine, which is the condition that arises when the machine is bus excited. Data obtained from a self-excited machine is useless for the determination of the proper regulating resistance, and yet this error is very often made. The condition where maximum resistance is required is for compound dynamos, where they are subject to overload or short-circuits, and in this case the shunt field has to be cut down to nearly zero, in order to control the load when it is necessary to burn out a short-circuit with a compound dynamo, which case arises in railway work.

In order to determine the resistance to properly regulate a dynamo, connect in series with the field a variable resistance, and an amperemeter, and then connect the ends of the field to an external source of electromotive force, equal to the maximum given by the dynamo, and when the machine is running at normal speed, insert resistance until the voltage drops at the brushes with armature or open circuit to 10 per cent. below the rated voltage of the machine; then take drop across the inserted resistance with voltmeter and from amperemeter reading figure resistance; then overload the machine, as allowed by the manufacturer, if compound, and see if the resistance is sufficient to control the machine under these conditions, which it should be, if properly compounded.

The number of steps into which this regulating resistance is divided for lighting and power generators, is from forty to eighty; the latter division, if the resistance is properly divided throughout the box is abundant for the best regulation, which is to have the same volts drop on each step, and, with the tapering current, will give low resistance steps at beginning of box, and resistance increasing per step as the current through field decreases.

The method of figuring the resistance wire, in order to secure maximum economy in space and material, will be found in Sheet 2 (to follow).

5733. Sheet 2. ERECTION OF TROLLEY WIRES AROUND CURVES. B.



5733. Sheet 1. ERECTION OF TROLLEY WIRES AROUND CURVES. B.

In a properly erected trolley wire, and with a standard trolley wheel, the pole should never leave the trolley wire in going around curves, and this result can be obtained if the trolley wire is erected with the following precautions:

First—All line tensions should be taken off the trolley wire at the end of both tangents to the curve. This can be done by running strain wires to take up this tension. The location of the curve of the trolley wires should not be directly over the center of the track, except at the points of tangency, but should depart from this curve toward the center, the departure being greater as the radius of the curve decreases. For a 50-foot curve, the trolley wire should be 8 inches inside of the center line of the track, at center of 90-deg. curve. (See Fig. 1, Sheet 2.)

Table 1 shows what this should be for the 90-deg. curves of different radius.

TABLE 1.

Radius in feet.	Distance between centre of track and centre of trolley.	Distance between pull-offs on curves.	Radius in feet.	Distance between centre of track and centre of trolley.	Distance between pull-offs on curves.
35	14"	6"	100	4"	12"
40	12"	7"	120	4"	14"
45	10"	8"	140	4"	14"
50	8"	9"	160	3"	14"
55	7"	10"	180	3"	14"
60	7"	11"	200	3"	14"
70	6"	12"	250	3"	16"
80	6"	12"	300	2"	16"
90	5"	12"	350	2"	16"

In regard to spacing the pull-offs around the curves, Table 1 shows the distance apart that they should be placed in order that the sides of the polygon formed by the trolley wire and pull-offs, will not be of such an angle as to throw the trolley when passing around these curves. In any case, the deflection of the trolley wire at any one pull-off ear should not be more than 10 deg.

With curves laid out with a spiral between the curve and the tangent, it is not necessary to make any difference in guying the trolley wire.

Sheet 2 shows a number of methods of locating pull-offs in order to hold the trolley wire to the proper curve. The original method consists in attaching the pull-off guy directly from the trolley to the pole. These pull-offs, as usual, are provided with turn-buckles, so that the pull-offs can be varied in length, adjusting the trolley to the proper curve. The other general method is the flexible method, where the trolley wire is connected to a heavy span wire by means of pull-offs, and this method has the advantage of equalizing the strains on the different pull-offs, and tending naturally to hold the trolley wire to a curve.

Press of THE CHEROUNY PRINTING AND PUBLISHING CO., 17-27 Vandewater St., New York.

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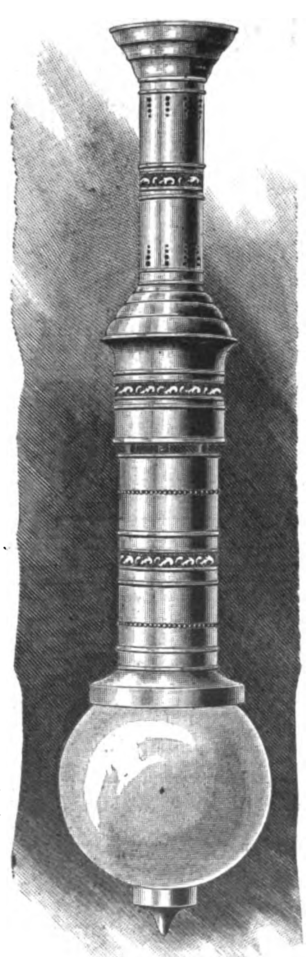

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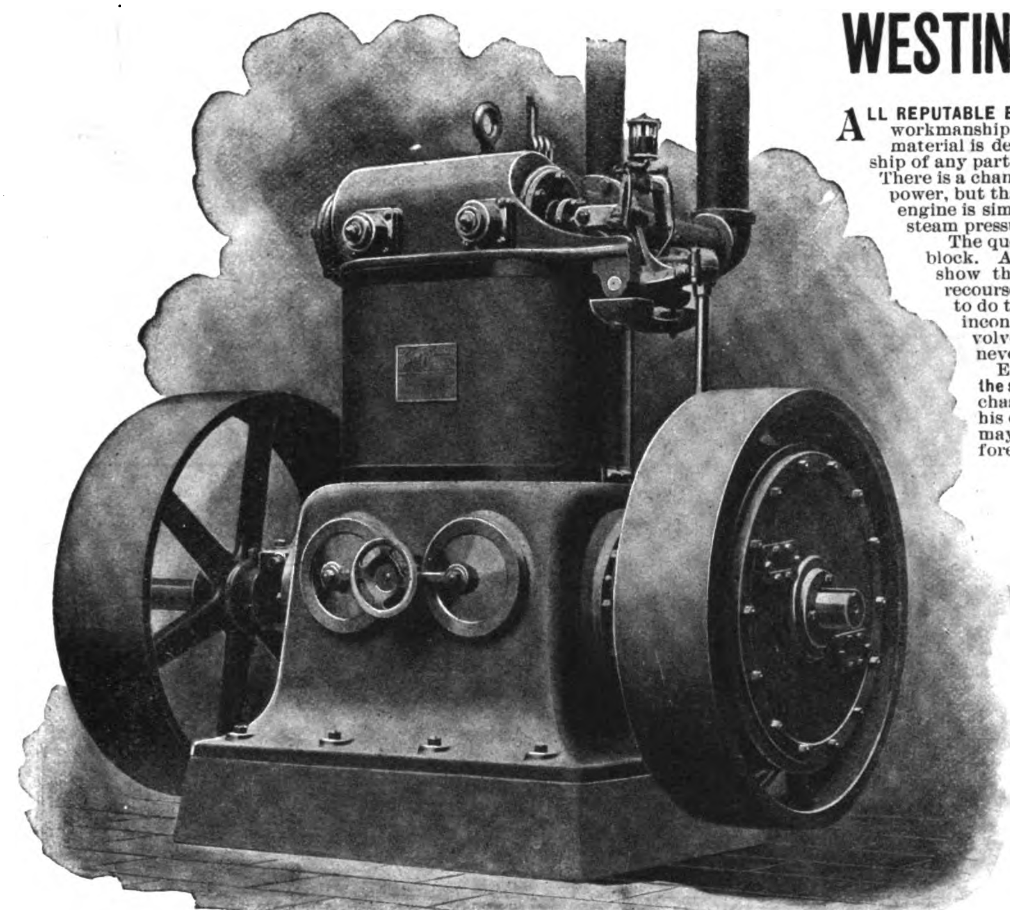

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The question of economy, however, is the stumbling-block. After an engine has been installed and fails to show the **guaranteed economy** the purchaser has no recourse except to take the engine out. If he decides to do this, it means interrupted business and serious inconvenience, aside from the direct expense involved. The consequence is, that it is seldom or never done.

Every engne we build has a record **before leaving the shop**, based on a rigid economy test. Any purchaser so desiring may have his engine tested by his own expert at our shops before shipment, and may accept or reject the engine on that test, before incurring the expense of installation.

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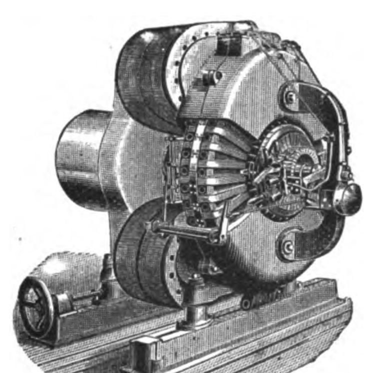

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Sizes: 15 to 200—2,000 C. P. Lights.
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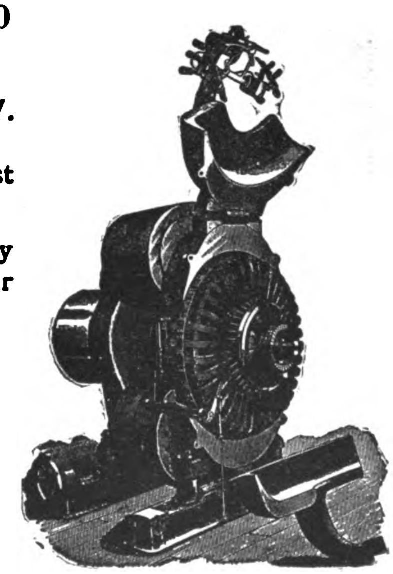

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FINANCIAL.

ALBANY, N. Y.—The capital stock of the Albany, Helderberg & Schoharie Electric Railway Co. has been increased from $300,000 to $500,000.

STREATOR, ILL.—C. C. Barr has been appointed receiver of the Streator Railway Co. under foreclosure of the $160,000 mortgage. The capital stock of the road is $250,000, and it has been in operation five years.

YOUNGSTOWN, O.—The Youngstown Street Railway Co., and the Mahoning Valley Electric Railroad Co. have been consolidated; the new company to be known as the Mahoning Valley Railroad Co. A. A. Anderson, of Youngstown, is general manager. The Mahoning Valley Railway Co. has filed with the Secretary of State an application to increase the capital stock from $150,000 to $1,500,000 and change the headquarters to Youngstown.

SALISBURY, N. C. will vote on a proposition to issue $100,00 worth of bonds to purchase the city water works and put in an electric light plant.

BALLARD, WASH.—This city has decided to purchase an electric lighting plant, and bonds or warrants will be issued for that purpose. Of the $51,000 authorized for water and electric lights, only $45,000 have been sold, and it is proposed to use the balance for the lighting plant. Bids will shortly be advertised for.

CUMBERLAND, MD.—The Cumberland City Council is considering an ordinance to submit to the voters for an issue of bonds to the amount of $20,000 for an electric light plant.

ELECTRIC RAILWAYS.

PITTSBURG, PA.—Over half a million dollars, it is said, will be expended by the North Side Traction Co. next spring in improving its road, to include a power plant to cost $150,000 to $200,000.

NEWARK, O.—The Ohio Telephone Exchange Association will soon form a company to connect Ohio's sixty independent exchanges, also the forty-five in Indiana, and several in adjoining States. A meeting will be held in Columbus next month for that purpose.

GREENWICH, N. Y.—The application of the Greenwich & Schuylerville Electric Railroad Co. for permission to construct its road has been granted by the State Railroad Commissioners.

MT. VERNON, O.—A. S. Shoemaker, of Ashley, is engaged in establishing an electric railway from Mt. Vernon, Knox County, to Richwood, Marion County, passing through Sparta, Marengo, Ashley and Prospect.

WINNIPEG, MAN.—An application has been made for charter for the Fort Frances & Pacific road, through the Rainy Lake gold country, from Wabigoon station on the C. P. R., electricity to be the motive power, derived from the numerous waterfalls on the route. Subsides are asked from both Provincial and Dominion Governments.

ST. LOUIS, MO.—The People's and the Arsenal Street Railway Companies have decided to consolidate and build several extensions in the suburbs. Charles Green is president of the People's Company.

NEVADA, MO.—H. C. Moore, of this place, has perfected arrangements with St. Louis capitalists for the construction of an electric railway in Nevada, Mo.

MILFORD, CONN.—At the opening of the general assembly in January, an elaborate trolley scheme will be promulgated. A petition has been prepared and signed by J. D. Brown, of Milford, and others, asking for power from the legislature to organize and operate the Milford Traction Company. A franchise for a line of electric road extending from Milford to Stratford, through Wodmont to the city of Derby and through Orange to New Haven over the old turnpike, is asked for.

TELEPHONE.

CHESTER, ILL.—The Harrisonville Telephone Company will begin work next week on the extension of its line from Evansville to this city. It is proposed to connect all towns in this section of Southern Illinois by a telephone system.

CHILLICOTHE, O.—Mr. Isaac McCormick, of Raysville, has completed arrangements with the Home Telephone Company, for the carrying out a new telephone system. The idea which Mr. McCormick advocates is the connecting of Wellston, Coalton, Jackson, McArthur, Hamden, Byers and Raysville with Chillicothe. The new line will tap the Chillicothe line at Vigo.

TOLEDO, O.—The Central Union Telephone Company has removed to its new exchange in the Spitzer Building.

BIGBYVILLE, TENN.—J. D. Hinds, of the Citizens' Telephone Company at Columbia, has surveyed and staked off the line to connect Bigbyville with Columbia. Work will begin upon the construction of the line immediately. It is probable that McCain's and Broadview will connect with this place soon.

GAINESVILLE, TEX.—The National Telephone Company has been absorbed by the local Bell Telephone Company.

NACOGDOCHES, TEX.—A telephone line is being put up from here to St. Augustine, which is thirty-five miles east, via Melrose, ten miles east, and Chireno, twenty miles. It was inaugurated by a stock company under the leadership of Mr. John T. White.

DENVER, COLO.—The Denver Telephone Company has filed an application with the board of public works for authority to excavate and lay a conduit for their lines in the avedp portion of the city and for permission to erect poles for telephone lines in the unpaved part of the city.

See further, page xiii.

ELECTRIC LIGHT.

CHICAGO, ILL.—The Deputy Sheriff, Dunphy, received an attachment for $8,812 against the Jonathan Clark & Sons Company, of Chicago, in favor of the Western Electric Company for balance claimed to be due on putting an electric light plant in the Park Building at Pittsburg, Pa. It was served on a third party in New York who said there was enough money in his hands to pay the attachment in full.

PORTSMOUTH, N. H.—The Portsmouth navy yard is to have an electric lighting plant.

JACKSONVILLE, FLA.—It is reported that Arthur T. Parker and H. C. Bullard, trustees for the Union Trust Company, who purchased the plant of the Jacksonville Electric Light Company, will take steps immediately towards rebuilding the plant.

WASHINGTON, N. C.—This town contemplates putting in an elecric light plant in the next 60 days. S. T. Nicholson is mayor.

FLATONIA, TEX.—The people of this city would be glad to have some company put in an electric light plant. R. O. Faires is mayor.

GAFFNEY, S. C.—The sum of $2,000 has been appropriated for additional arc lamps.

See further page xiv.

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ELECTRIC LIGHTING

BY

FRANCIS B. CROCKER, E. M. Ph. D.,

Professor of Electrical Engineering, Columbia College, New York; Vice-President of the American Institute of Electrical Engineers.

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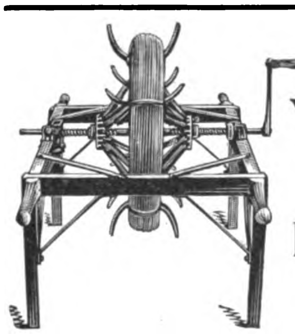

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MISCELLANEOUS.

FLEMINGTON, N. J.—The village trustees have passed an ordinance forbidding the stretching of telegraph, telephone or electric light wires along or across the streets of Flemington, unless permission in writing is first obtained.

ST. LOUIS, MO.—The General Electric Development Company of Bernalillo County has been formed. Incorporators: Harry Johnson, Edward A. Pearson and John Tascher. Capital stock, $250,000.

SILVER CITY, IDAHO.—The Trade Dollar mine has recently entered into a contract with a Denver firm for an electric power plant. This plant will furnish drill power for extending the works below the main tunnel, which is 1,200 feet below the apex of the mountain.

ELECTRIC LIGHT.

MARION, S. C.—An electric light plant is being put in by J. E. Duval, of Charlotte, N. C.

OSWEGO, N. Y.—The People's Electric Light and Power Company are increasing the capacity of their plant.

OPHIR, COLO.—An electric light system is be established here. Surveys have already been made. Power will be brought from the Nunn power plant at Ames, which supplies the power for the surrounding country and the Telurlde district.

MILLBURN, N. J.—The Millburn Electric Company has commenced work by erecting electric light poles along Millburn avenue.

ORANGE, TEX.—An accident to the electric light station has occurred. Loss estimated at $5,000; insured in Hartford Steam Boiler Company.

WASHINGTON, D. C.—At the regular meeting of the board of directors of the United States Electric Lighting Company, the following officers were elected: President, A. A. Thomas; first vice-president, ames L. Norris; second vice-president, Dr. Thomas O. Hills; secretary, Seymour W. Tulloch; treasurer, John W. McCartney; cashier, Edward S. Marlow.

AMHERST, MASS.—The new electric light station has been completed and put in operation.

See further, page xvii.

ELECTRIC RAILWAYS.

CHARLESTON, S. C.—The Enterprise Railroad Co. has decided to use the trolley system on its lines. T. W. Passailaigue is president. The company controls thirteen and one-half miles of line.

KANSAS CITY, MO.—The West Side Street Railway Co., it is reported, is about to begin operations on its electric line. It has deposited a forfeit to insure the completion of the work.

KANSAS CITY, MO.—The Northeast Electric Railway Company has been formed; capital, $250.000. Incorporators: Edmund G. Vaughan, Samuel M. Jarvis and Milton Moore.

PHILADELPHIA, PA.—The Calhoun street bridge has been purchased by a syndicate headed by Col. Edward V. Morrell for $120,000, and it is said that it will be used by the proposed electric road which is to run from Philadelphia to Trenton.

RANDOLPH, MASS.—The Randolph, Fall Brook & Nantasket Beach Street Railway Co. has been incorporated, with a capital stock of $13,800, to build a line 5½ miles in length.

HOMESTEAD, PA.—The Homestead and Highlands electric line will be extended from Munhall to the Rankin bridge at once. The extension will be over two miles long, and the estimated cost is $50,000.

FORT WORTH, TEX.—The Glenwood & Polytechnic Co. has bought the Samuels avenue line of the City Railway and will extend and repair it. J. T. Voss is president.

BUFFALO, N. Y.—The Buffalo Traction Co. have bought out the Buffalo, Kenmore and Tonawanda R. R., an electric road 10 miles in length. They will add 66 miles of track to the Buffalo end of the line.

OSHKOSH, WIS.—The franchise and effects of the Central Wisconsin Electric Railway have been sold at auction. W. H. Clark, of Chicago, was one of the purchasers.

See further, page xix.

ELECTRIC LIGHT.

PHILADELPHIA, PA.—A large warehouse and office building for Messrs. Ford & Kendig is to be furnished with electric light and electric elevators.

TACOMA, WASH.—The board of public works announces that the new 1,000-lamp dynamo loaned to the city by the General Electric Co. until the 2,000-lamp machine arrives is now in place and the city is ready, the board says, to furnish more incandescent lighting.

BRISTOL, TENN.—A charter has been granted to the Consumers' Electric Light Co., of Bristol. The incorporators are Albert Partlett, John D. Thomas, C. L. Sevier, S. L. King and W. K. Vance.

BAINBRIDGE, GA.—An electric light plant is among the early probabilites for Bainbridge—to be owned by private parties—who propose lighting the town with arc lights and supplying private parties with arc or incandescent lights for use in stores, shops and private residences.

EAST AURORA, N. Y.—At the annual meeting of the East Aurora Electric Light Company, the following directors were elected: Henry H. Persons, Dr. M. B. Searles, Frank R. Whaley, Ezra Smith, H. W. Richardson.

WEST SPRINGFIELD, MASS.—The town proposes to have an electric light of its own.

BLOSSBURG, N. Y. expects to have an electric light plant

PEORIA, ILL.—W. H. Becker says that next spring he is going to put in a complete electric plant of his own in the Niagara building. He will light the building and operate the elevator with his own plant.

See further page xxi.

Central Station Equipments

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TELEPHONE.

MERIDIAN, MISS.—A telephone line from Meridian to Hattiesburg will be completed at an early date. This line will be about 100 miles long and will connect the following New Orleans and Northeastern Railroad towns: Meridian, Enterprise, Pachuta, Vosburg, Heidelberg, Sandersville, Laurel, Ellisville, Melrose, Eastabuchie, and Hattiesburg.

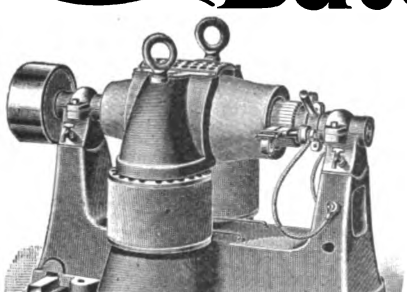
ALBANY, N. Y.—At the annual meeting of the stockholders of The Home Standard Telehone Company, the directors elected the following officers: President, John M. Bailey; first vice, James Rooney; second do., Henry Russell; secretary, Charles L. A. Whitney; and treasurer, Howard Hendrickson.

SAN JOSE, CAL.—Articles incorporating the People's Telephone Company have been filed with the County Clerk. The capital stock is placed at $50,000, of which $525 has been subscribed. The object of the corporation is to carry on a general telephone business in San Jose and vicinity. George E. Crothers, Elmer E. Chase, H. J. B. Wright, C. F. W. Herrmann and Ernest P. Lion are the incorporators.

TOLEDO, O.—The exchange of the Central Union Telephone Co. has been removed to the Spitzer Building, where new apparatus has been installed with a great increase in the rapidity and efficiency of the service.

LOCKPORT, N. Y.—According to a reliable report, the Bell Telephone Company is planning to spend a large sum of money in this city in various improvements, including the construction of a telephone exchange building, which is to cost about $10,000.

See further page xxii.



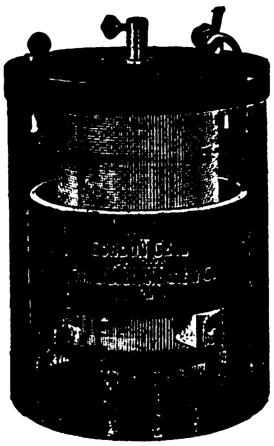
ELECTRIC RAILWAYS.

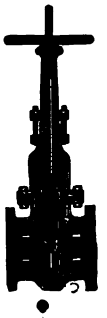
ROSSVILLE, GA.—An application has been filed in the State of Georgia for a charter for the Chattanooga Rapid Transit Co. Among the incorporators are: Samuel W. Divine, W. B. Royster, Charles D. Divine, John W. Wyatt and others, of Hamilton County, Tennessee; J. A. McFarland and R. B. Stegall, of Walker County, Georgia. The incorporators propose to build an electric line from near Rossville, Ga., in a southern direction for ten miles through Catoosa and Walker Counties, but no definite plans have been decided upon. The capital stock of the new company will probably be $150,000.

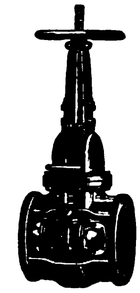
BRISTOL, PA.—The electric road has been completed from Langhorne to Bristol. The fare between the two towns has been fixed at 15 cents and 25 cents for the round trip. The steam railroad fare for the round trip between Bristol and Doylestown is now $2.20, but the distance has been shortened about 30 miles by the new electric line so that the round trip can be made for $1.78. The road is about 8½ miles in length.

CINCINNATI, O.—The Cincinnati & Miami Valley Traction Co. has been incorporated with a capital stock of $650,000. The line will be built from the present terminus of the lines of the Dayton Traction Co. at Miamisburg, through Middletown to the court house in Hamilton. The contract has been made with Messrs. Stern & Silverman, Philadelphia, for the building of the road, including the road-bed, cars, overhead construction, power stations and car barns, and they have agreed that it will be completed by July 1, 1897.

See further, page xxv.







TELEPHONE.

DUNKIRK, N. Y.—E. E. Summery, of Buffalo, has been in the city in the interests of the Automatic Telephone Company to organize a local company in this city and Fredonia, for which a charter was granted several months ago. He expects that the work of construction will begin about Jan. 1.

SOUTH ORANGE, N. J.—The Orange Telephone Company's application for a franchise to string wires in the township was referred to a committee.

NATCHEZ, MISS.—The projectors of the telephone company, viz., Lemuel P. Conner, W. P. Stewart, A. G. Campbell, James Farrell, J. A. Clinton and J. O. French, have presented their acceptance of the telephone ordinance and franchise.

BEAUMONT, TEX.—The East Texas Telephone Company has been formed at Beaumont; capital stock, $5,000. Directors: C. A. Epping, T. E. Spotswood, R. E. Lundy, and C. E. Jones.

CAMDEN, N. J.—The Camden Telephone Company, which was recently incorporated, is seeking franchise to construct lines through Camden. The company's capital stock is $250,000, and it is said that $85,000 has been paid in. The incorporators names are Chas. F. Ludington and R. D. Kelly, of Jersey City, and Clarence W. Hughes, of Brooklyn.

ELKTON, MD.—The Cecil Telephone Company, with all its fixtures, was sold at an assignee's sale, to R. C. Levis, of Elkton, for $600.